HSV-160B+ Series

Full Digital AC Servo Drive Unit

User's

Manual

(Version 1.0)

Wuhan Golden Age Motor Technology Co.,Ltd.
Nov. 2011

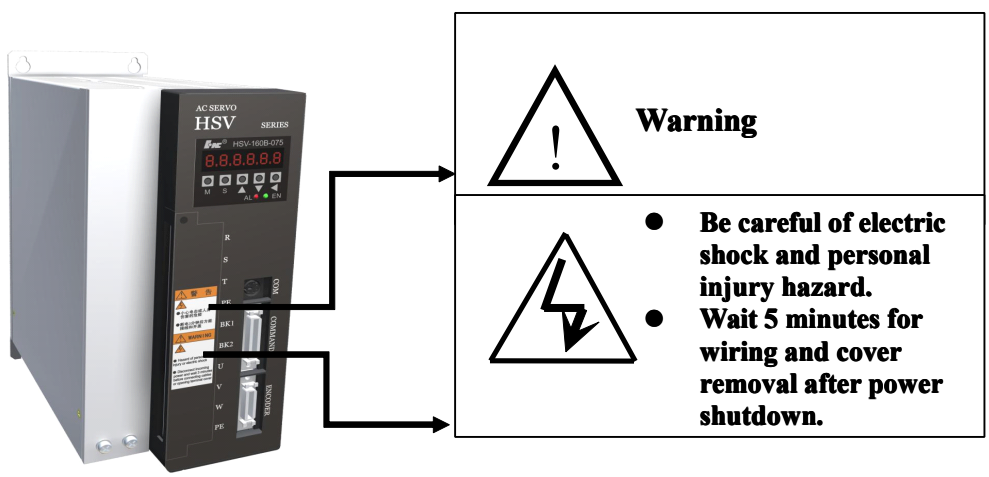
Chapter 1 Safety Precautions

Thank you very much for your using AC Servo Drive Unit HSV-160B+. We provide servo drives and motors for common industrial applications. However, the following instructions must be strictly observed:

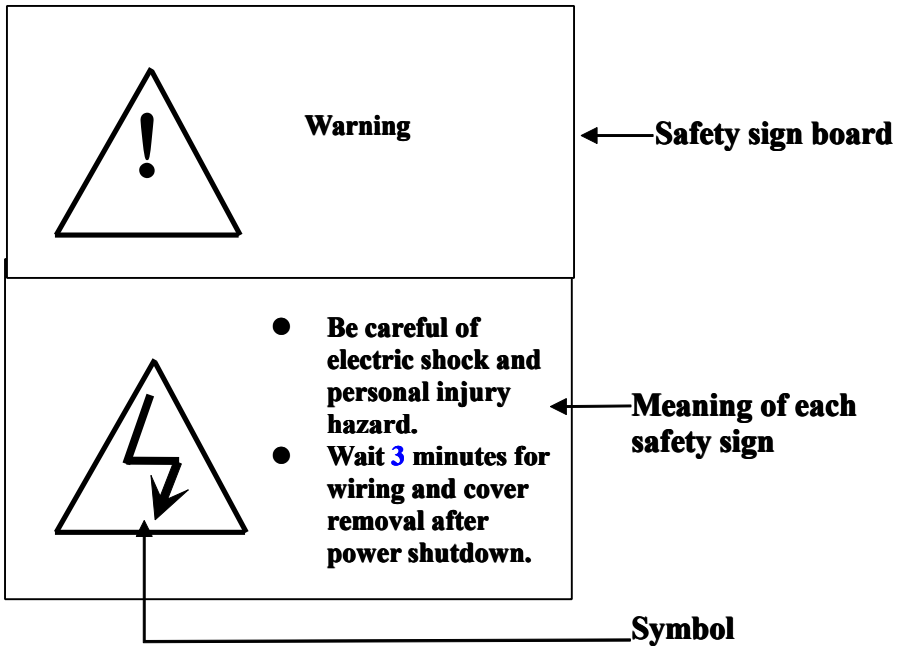
- Do not place the servo drive and motor in the environmental conditions of strong vibration.
- Do not use the servo drive and motor for life safety concerned medical equipment.
- Do not subject the servo drive to the rain or direct sunshine, since it is not waterproof structured.
- Do not make any changes or modification to the servo drive and motor.

Attention: Before correct installation and wiring, read through this manual carefully. Before operation, you should have good knowledge of safety information and precautions, and device usage.

1.1 Warning symbols on the product



1.2 Meanings of symbols for warning



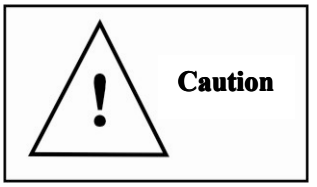
1.3 Explanation of safety concerned symbols

Incorrect use of the product could result in hazards, personal injuries and even death.

Incorrect use of the product could result in light or medium level personal injuries and damages to the product.

1.4 Safety notice

■ Check and confirm on delivery



- Do not install the damaged servo drives; otherwise, you may get injured.
- Use the servo motor and drive in the specified combination, otherwise, it could result in fire or fault.

■ Installation

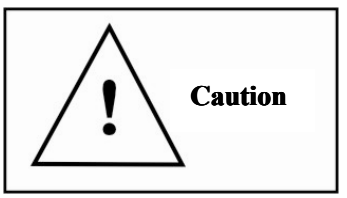
- Lift the bottom of the device for displacement. If you hold only the panel, the servo drive host may drop from your hand, and you may get injured.
- This product should be fit to the noncombustible flat surface, such as metals. Failure to follow this instruction could result in fire.
- Make sure the inlet and outlet of the product are unobstructed. Prevent foreign bodies from entering the product. Failure to follow this instruction could result in aging of internal components and thereby cause fire and/or fault.
- Keep the specified space for servo drive and the switching cabinet and other devices when carry out installation. Failure to follow this instruction could result in fire and/or fault.

■ Wiring

- Wiring is supposed to be done by electrical engineers. Failure to follow this instruction could result in electric shock and/or fire.
- Before wiring, confirm the power is off. Failure to follow this instruction could result in electric shock and/or fire.
- Power terminal and motor connection terminal should be fastened tightly. Failure to follow this instruction could result in

electric shock and/or fire.

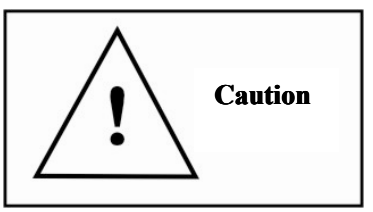
- Do not touch the output terminals directly or connect the output wires with the servo drive outside shell. Never short the output terminals. Failure to follow this instruction could result in electric shock and/or short circuit.



- Safety devices like breakers should be installed to avoid short circuit of external layout. Failure to follow this instruction could result in fire hazard.
- Verify the power voltage of AC main circuit is corresponding to the nominal voltage of the servo drive. Failure to follow this instruction could result in injuries and/or fire hazard.
- Do not do the voltage resistance test to the servo drive; otherwise, the semi-conductor components of the servo drive could be damaged.
- Do not connect the power cables with output terminal U, V, W; otherwise, when voltage adds on the output terminal, the internal parts of the servo drive could be damaged.
- Do not connect capacitor and (LC/LR) noise filter with terminal U, V, W in the output loop; otherwise, the servo drive could be damaged.
- Do not connect electromagnetic switch or contactor with terminal U, V, W in the output loop. In the load-operation, the surge current could activate the over current protection circuit of the servo drive.

■ Debugging and Operation

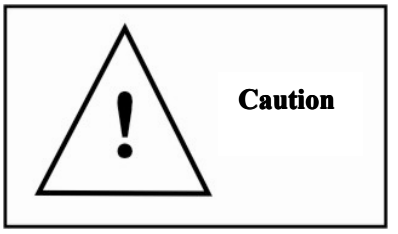
- To avoid unexpected accidents, servo motor test run should be carried out respectively (free from connection to the transmission shaft). Failure to follow this instruction could result in injuries.
- Do not disassemble the servo drive with power present. Failure to follow this instruction could result in electric shock.
- Do not approach to the machine in trial operation with power present. (Take personal safety into consideration when perform mechanical and electrical design).



- Do not touch the servo drive heat sink, brake resistor or the motor with power present or just switched off, since the temperature of them could be high. Failure to follow this instruction could result in burns.
- Before operating, reconfirm the technical datum of the servo motor and other devices. Failure to follow this instruction could result in injuries.
- If it is necessary to use external brakes, prepare separately; do not touch the brakes in operation. Failure to follow this instruction could result in injuries.
- Do not check signals in operation, otherwise, the servo drive could be damaged.

■ Troubleshooting

- Wait 5 minutes for wire removal after power shutdown of the servo drive, since the voltage may still remain high for some time. Failure to follow this instruction could result in electric shock.
- Operations (such as wiring, installation, running, disassembly and maintenance) must be performed by the specified professional personnel. Failure to follow this instruction could result in risks of electric shock and/or damages to the servo drive.



- The control circuit board adopts CMOS integrated circuit (IC), therefore, you should take anti-static measures in maintenance, otherwise, the electrostatic induction could damage the control circuit board.

■ Adoption of servo motors

- The nominal voltage of the servo motor must be greater than the constant torque loads valid. Otherwise, the servo motor could be damaged for long-time overload.
- The ratio of load inertia and servo motor inertia should be less than the recommended value.Otherwise, the device could be damaged.
- Use the servo motor and drive in the specified combination. Failure to follow this instruction could result in damages to the device.

■ Others

- Do not make changes or modifications to the device by yourself. Failure to follow this instruction could result in risks of electric shock and injuries.

Chapter 2 Overview

HSV-160B$^+$ is a new product of full-digital AC servo drive after HSV-11, HSV-16 and HSV-160 developed by Wuhan Golden Age Motor Technology Co., ltd.. It features all characteristics of compact structure, ease of use and high reliability.

2.1 Product introduction

HSV-160B$^+$ AC servo drive adopts the latest technological designs，such as Digital Signal Processing (DSP) for motion controller and Intelligent Power Module (IPM). It features a few characteristics:

- A small size body;
- Easy to install and operate;
- High reliability.

Highlights of HSV-160B$^+$ AC servo drive:

1) Easy and flexible control

To meet different work requirements and/or environmental conditions, you can make revisions to the servo drive parameters to change its operating mode and/or internal parameters. You can also preset a few sets of characteristic parameters, and alternate automatically according to the machining situations.

2) Full status display

HSV-160B$^+$ AC servo drive provides a series of status display. It enables users to browse the related status parameters of the servo drive easily during debugging and operation. And it also provides a series of fault diagnostic information.

3) Wide range of speed adjustment ratio (relative to the motor itself and the feedback component selected).

The setpoint of maximum rotary speed of the motor can reach 12000 rpm in HSV-160B$^+$ AC servo drive system, and the minimum is 1 rpm. The range of

speed adjustment ratio is 1:12000.

4) Small size, easy to install

HSV-160B+ AC servo drive adopts a compact structure and a small size body, which makes it easy to install and disassemble.

5) Gain-switch function

To improve the transient characteristic of the operating motor with dynamic loads, you can preset standby characteristic parameters, and alternate automatically according to machining situations.

6) User-defined Signal Inputs/Outputs function

HSV-160B+ AC servo drive system preset 13 types of input functions and 10 output functions, of which, users can conveniently select 6 input functions and 3 output functions for setting, and define the validity of I/O signals high (low) level.

7) Servo motor code setting and autotuning function of the motor parameters

HSV-160B+ AC servo drive sets the motor code according to the motor type, and accesses to the motor parameters via autotuning.

2.2 Introduction of operating mode

There are five control modes for HSV-160B+ AC servo drives:

- Position control mode(pulse interface): HSV-160B+ AC servo drive can receive 3 types of pulse commands(orthogonal pulse, pulse + direction, positive and negative pulse) via setting internal parameters.
- Speed control mode(analogue interface): HSV-160B+ servo drive can receive analogs whose amplitudes are not higher than 10v(that is from -10v to +10v) via setting the internal parameters to switch to the speed control mode.
- Torque control mode (analogue interface): HSV-160B+ AC servo drive can receive analogues whose amplitudes are less than 10 v(that is from -10v to +10v) via setting the internal parameters to switch to the torque control mode.

- JOG control mode: In this mode, users can operate HSV-160B$^+$ AC servo drive manually with a keypad. It is a way to check whether the installation and connection of servo drive unit are correct or not.
- Internal speed control mode: In this mode, HSV-160B$^+$ AC servo drive can run at the internal preset speed.

Chapter 3 Specification

3.1 Servo drive specifications

Denomination explanation:

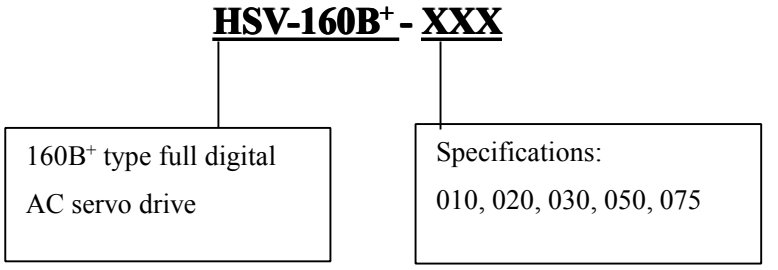


Table 3.1 Servo drive operating current

Servo Drive Specification	Continuous Current (A/30 min) (virtual value)	Momentary Withstand Current (A/1 min) (virtual value)
HSV-160B+-010	4.8	7.2
HSV-160B+-020	6.9	10.4
HSV-160B+-030	9.6	14.4
HSV-160B+-050	16.8	25.2
HSV-160B+-075	24.8	37.2

Table 3.2 Servo drive specifications

Power Input		3-phase AC 220V (-15 to +10%, 50/60 Hz)
Operating environment	Ambient temperature	In operation: 0 to 55 ℃ For storage: -20 ℃ to 80 ℃
	Relative humidity	< 90 % (no icing)
	Vibration	< 0.5G (4.9m/S^2), 10 to 60 Hz (noncontinuous operating)
Control mode	①Position control mode ②Speed control mode ③Internal speed control mode ④JOG mode	
Regenerative brake	internal\external For selection and connection of brake resistors, see the Annexure	

Characteristics	Speed frequency response	300 Hz or higher
	Speed fluctuation ratio	＜ ±0.1(load: 0 to 100%);＜±0.02 (Power supply: -15 to +10%) (This value should be corresponding to the nominal speed)
	Speed adjustment	12000:1
	Pulse frequency	≤ 500 kHz
Input control	①Servo enable ②Alarm clear ③Deviation counter clear ④Command pulse prohibition ⑤CCW servo drive prohibition ⑥CW servo drive prohibition	
Output control	①Servo ready for output ②Servo alarm output ③Output of target-position-achieve/ target-speed-achieve	
Position control	Mode of input	①Two-phase A/B orthogonal pulses ②Pulse + direction ③CCW pulse/CW pulse
	Electronic gear	1 to 32767/1 to 32767
	Feedback pulses	Motor encoder windings:1024 Pulse/r, 2000 Pulse/r, 2500 Pulse/r, 6000 Pulse/r
Ramp function (Acceleration and deceleration)	Parameter setting:1 to 10000 ms (0 to 2000 r/min or 2000 to 0 r/min)	
Monitoring function	● Motor rotary speed, current and torque monitoring ● Momentary position monitoring ● Position deviation monitoring ● Command pulse accumulation and frequency monitoring ● Rotor position monitoring ● Operating status monitoring ● Input/output terminal signals monitoring etc.	

Protective function	● Overspeed protection ● Mains overcurrent, overvoltage and undervoltage protection ● Overload protection ● Braking malfunction protection ● Encoder malfunction protection ● Control mains undervoltage protection ● Overtemperature protection ● Positioning out-of-tolerance protection etc.
Operation panel	6 bit LED segment with 5 keys
Adaptive load inertia	< 5 times of motor inertia

Servo drive unit installation dimension (Unit: mm)

Figure 3.1 HSV-160B+-010A servo drive installation dimension

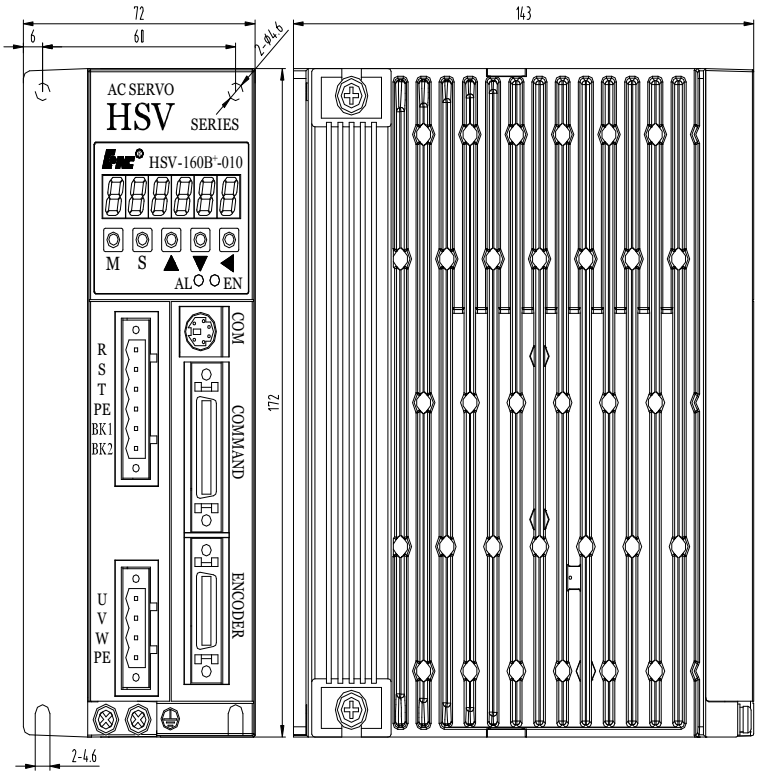


Figure 3.2 HSV-160B+-020/030A servo drive installation dimension

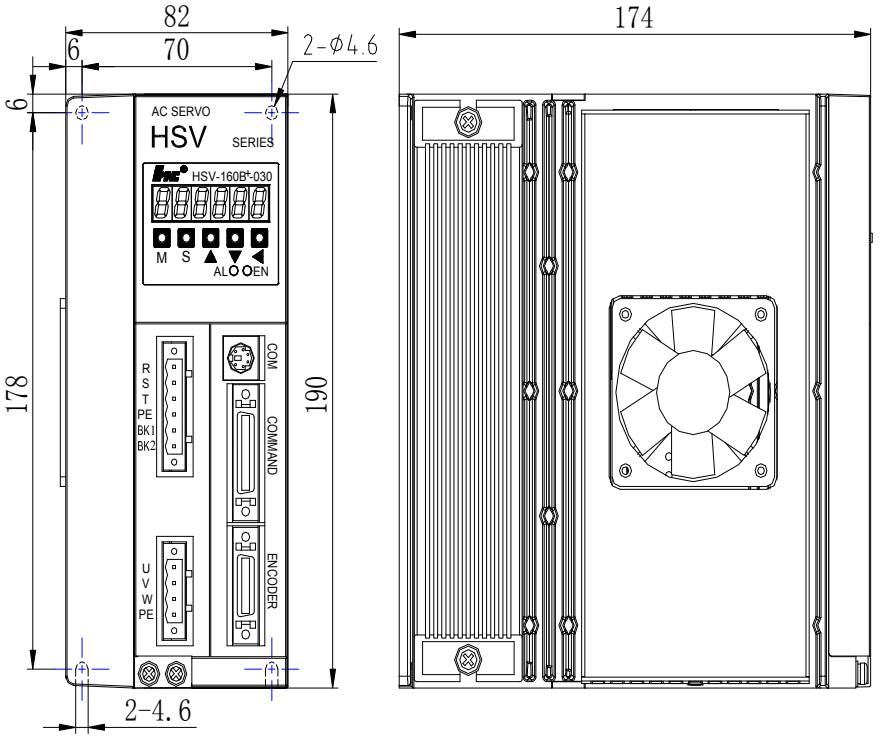
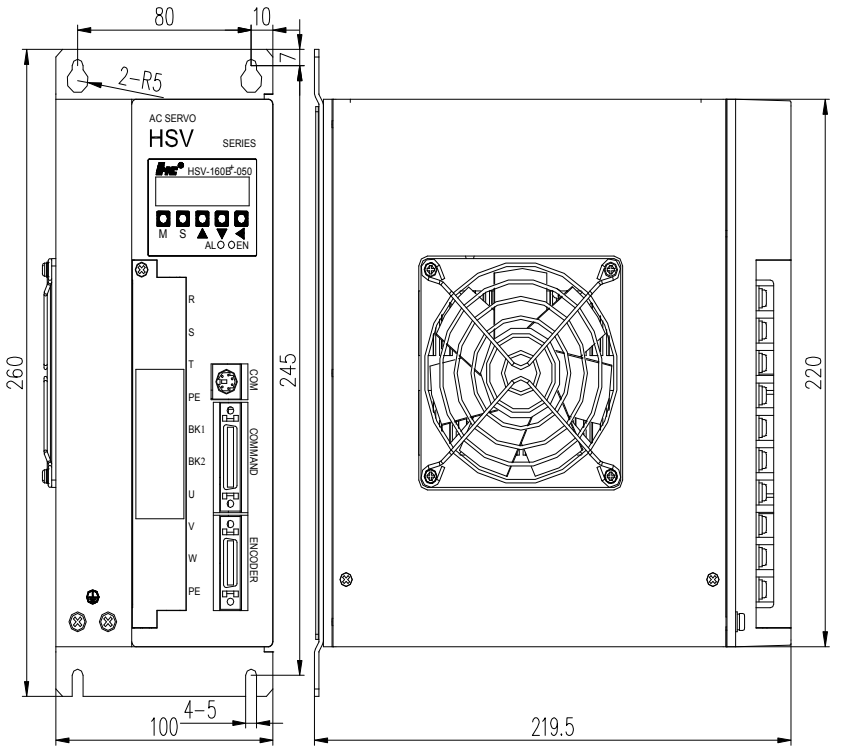


Figure 3.3 HSV-160B+-050/075A servo drive installation dimension



3.2 Isolating transformer specification

HSV-160B+ AC servo drive uses 3-phase or single phase AC 220v power supply. 3-phase 380/220v servo isolating transformer is recommended, and the capacity of isolating transformer depends on the servo drive system capacity. When you select the isolating transformer, it is necessary to take the servo drive system capacity for each axis into account comprehensively. You can consider step by step in the following way:

1) Select suitable motors based on the mechanical load inertia, torque and trasmission method adopted.
2) Select the servo drive type based on the selected motors.
3) Calculate the servo isolating transformer capacity based on the motor technical datum.

Example: If a system adopts three HSV-160 B+ AC servo drives whose motor powers are P_1, P_2, P_3, the servo isolating transformer power must observe the following formula:

$P_0 > (P_1+P_2+P_3) * \eta$

("η" is a conversion coefficient, and generally, adopts a value 0.6 to 0.8)

4) Select the servo isolating transformer specification corresponds to the calculated servo isolating transformer capacity.

Chapter 4 Installation

4.1 Check on delivery

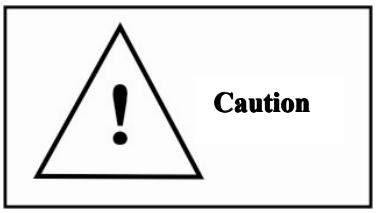
On receipt of products, users must check and confirm the following items:

Items to check	Content (for reference)
Whether the products are damaged or not	Visual inspection to check whether the products damaged or not during transportation
Whether the products are delivered in accordance with the indent or not	Check the nameplates of servo drive units and servo motors
Whether the accessories are complete or not	Check the packing list and make sure that the accessory type and quantity is correct.
Whether the motor rotor can be easily turned by hand	Check and make sure that the motor rotor can be easily turned by hand, except motors with brakes.

Note: For the items mentioned above, if there's any problem, please feel free to contact with the supplier or us.

Attention
● Do not install servo drives and servo motors which are damaged or with incomplete parts. ● Use the specified combination of servo drives and servo motors. ● Do not touch the motor rotor by hand directly, otherwise, it could cause corrosion.

4.2 Installation environment



- The servo drive are supposed to be installed in the well protected switching cabinet to prevent dust, corrosive gas, conductive foreign bodies, fluids and inflammables from entry.
- The servo drives are supposed to be installed in accordance with the specified direction and side distance to ensure good heat dissipation conditions.
- The servo drives and motors are supposed to be free from vibration and shock.
- The servo drives are not supposed to be installed near combustibles, in order to avoid fire hazard.

4.2.1 Protection requirements

Structural protection are not specifically designed for the servo drives, therefore, it is supposed to be installed in the well protected switching cabinet to prevent corrosion, combustible gas, conductive foreign bodies, metal powder, atomized oil and other fluids from entry of the servo drive .

4.2.2 Temperature requirements

- Ambient temperature: 0℃ to 50℃
- Safety long-time operating temperature: below 45℃
- Ensure good heat dissipation.

4.2.3 Vibration and shock loading

Avoid vibration during servo drive installation, and adopt Vibration damping measures to restrain the vibration below 0.5G (4.9m/S^2). No vibration and shock loading is permissible during servo drive installation.

4.3 Servo drive installation

Attention
● Servo drives are supposed to be installed in the well protected electrical cabinets.

- Servo drives are supposed to be installed in accordance with the specified direction and distance to ensure good heat dissipation conditions.
- The servo drives are not supposed to be installed adjacent to combustibles, in order to avoid fire hazard.

4.3.1 Installation method

1) Installing the device

Adopt base plate installation method, and install the devie in a vertical position. See Figure 4.1(4.2,4.3) for installing the device.

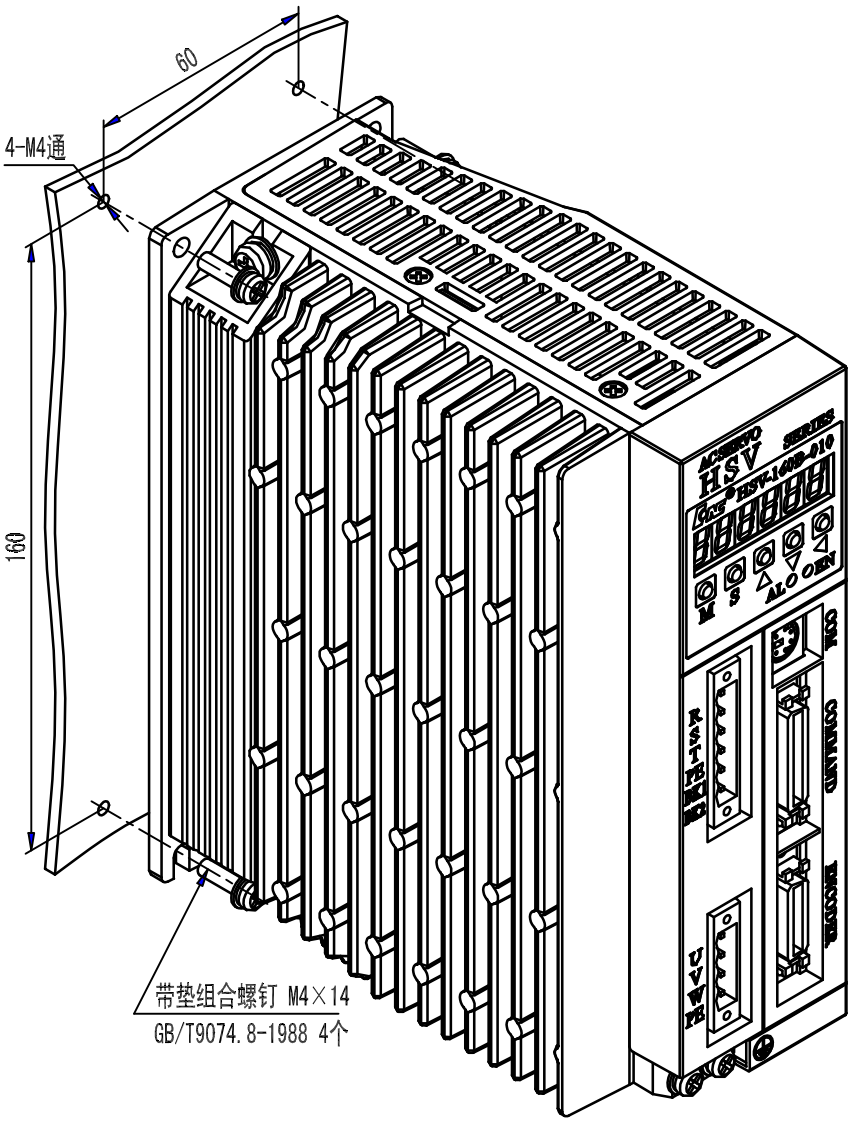
2) Installation spacing

Figure 4.4(4.6) shows the installing spacing for a solo servo drive and Figure 4.5(4.7) shows the installing spacing for multiple units. In actual installation, keep the spacing as large as possible to ensure good heat dissipation conditions.

3) Ventilation

In the electrical cabinet, airflow to the heat sink should be maintained to ensure adequate cooling of the ambient temperature of the device.

Figure 4.1 Schematic drawing of HSV-160B^{+}-010 AC servo drive base plate mounting



Combination of bolts with washer: M4×14 Standard: GB/T9074.8-1988 Quantity: 4

Figure 4.2 Schematic drawing of HSV-160B+-020/030 AC servo drive base plate mounting

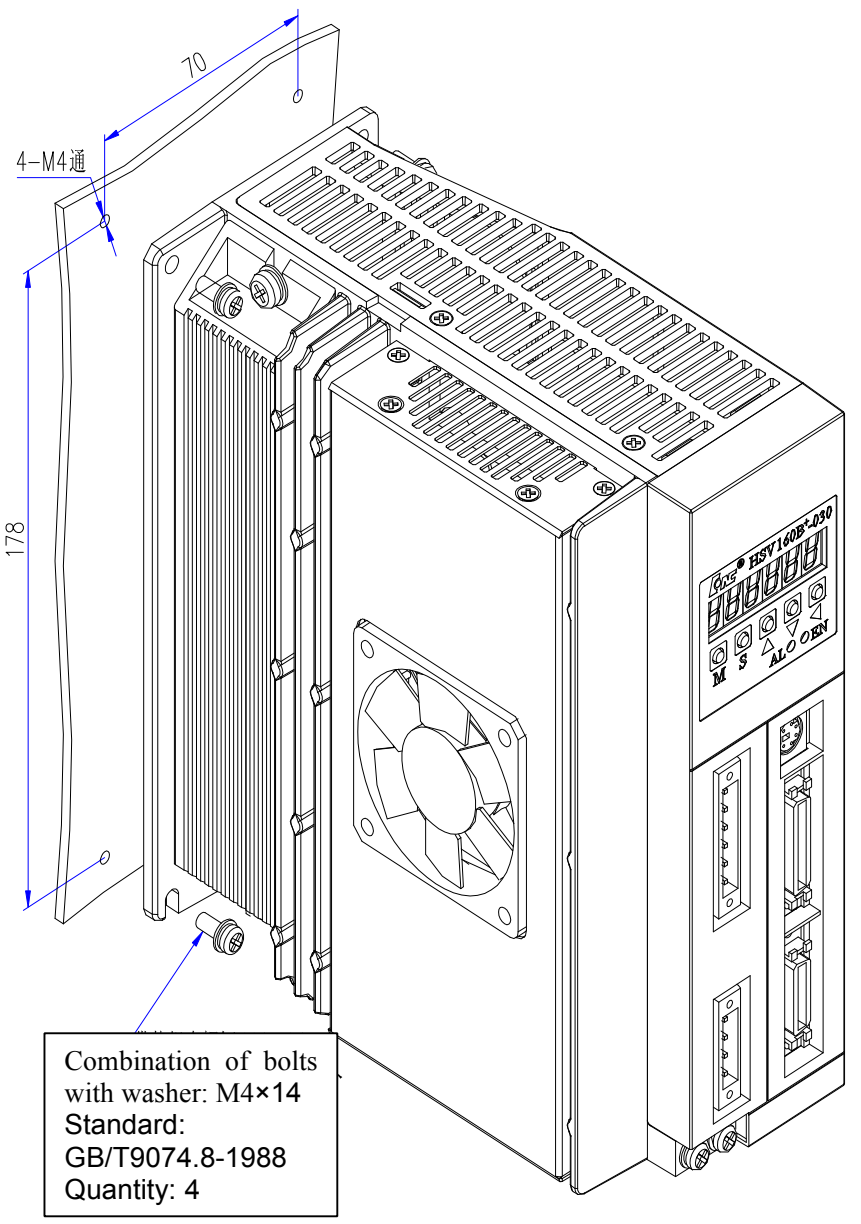


Figure 4.3 Schematic drawing of HSV-160B+-050/075 AC servo drive base plate mounting

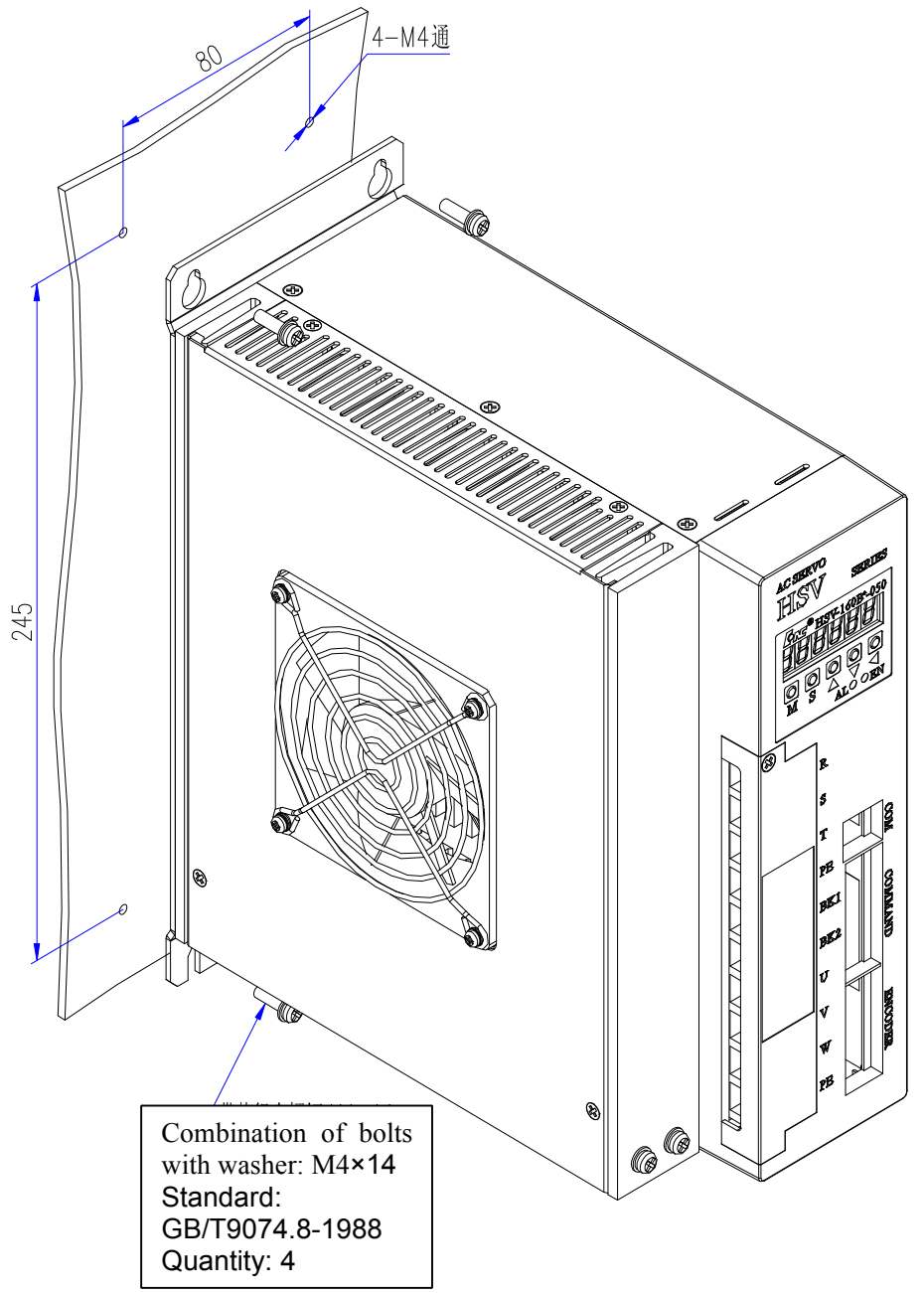


Figure 4.4 Installation spacing for a solo HSV-160B+-020/030 AC servo drive

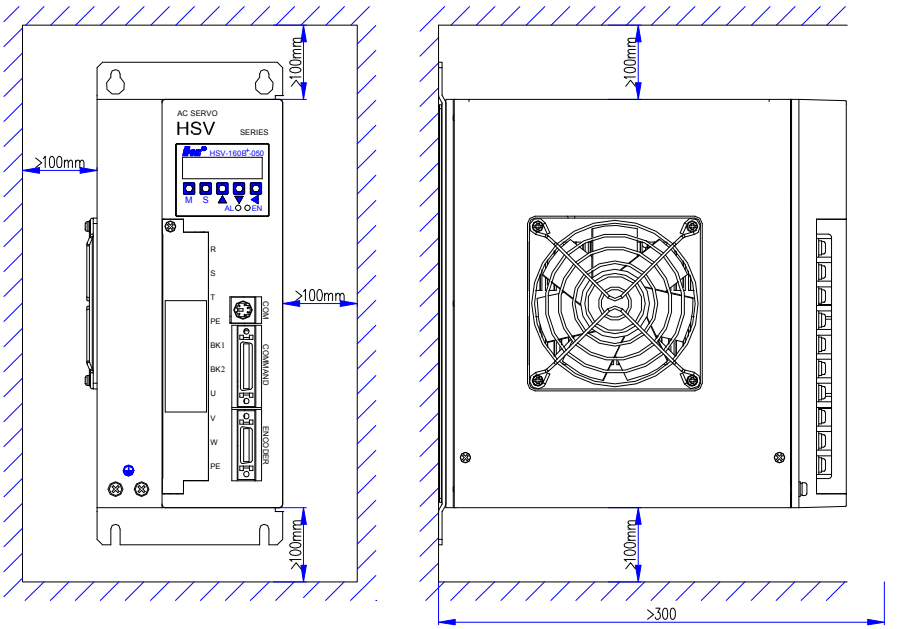


Figure 4.5 Installation spacing for the HSV-160B+-020/030 AC servo drive multiple units

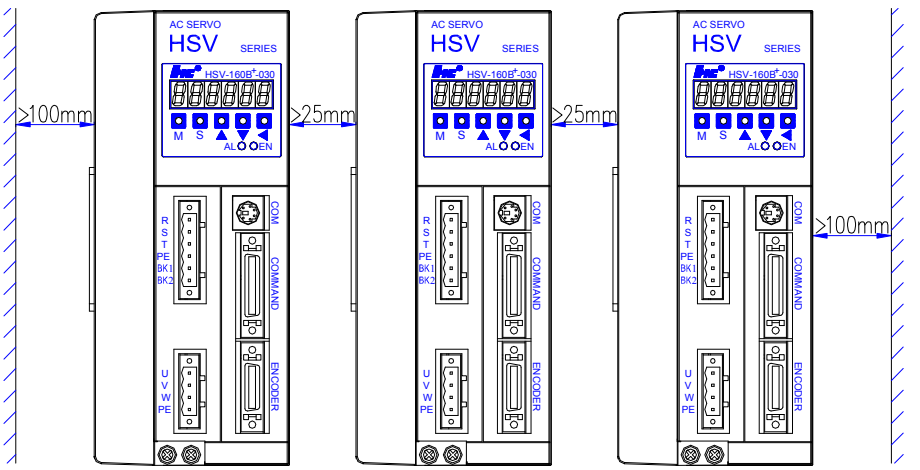


Figure 4.6 Installation spacing for a solo HSV-160B+-050/075 AC servo drive

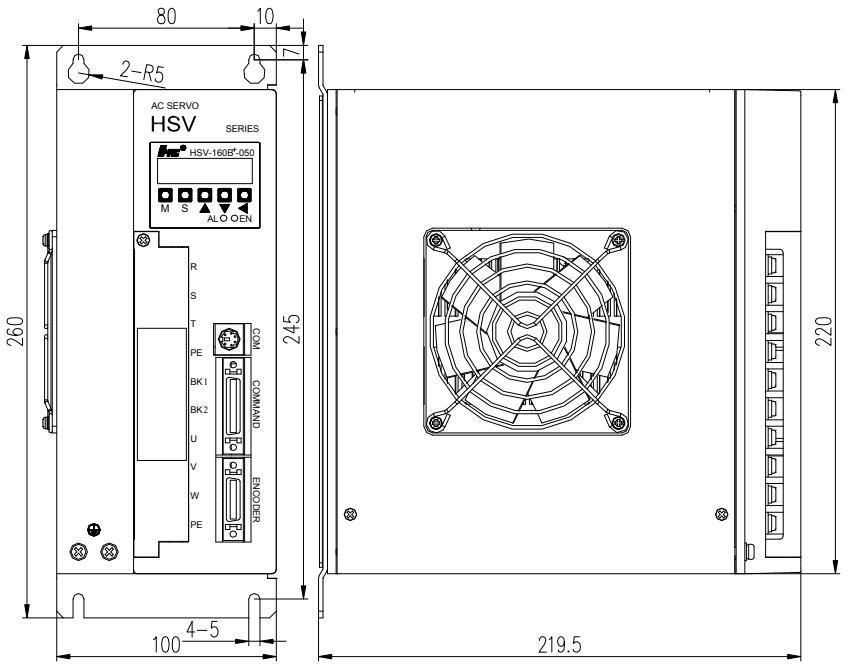
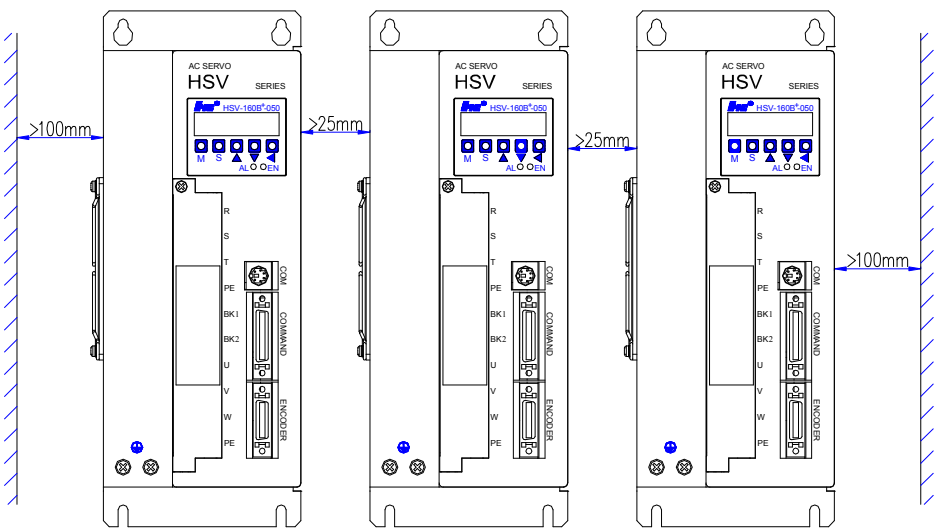


Figure 4.7 Installation spacing for the HSV-160B+-050/075 AC servo drive multiple units



4.4 Installation of servo motors

Attention
● To prevent the motor from vibration and impact, knocking on the motor rotor or encoder is forbidden. ● When transport the motor, you should not drag at the motor rotor, the outlet wires, or the encoder. ● Motor rotor cannot be overloaded, otherwise, the motor could be damaged. ● Make sure the motors are fastened, and take measures to avoid loose or drop out.

4.4.1 Installation environment

1) Protection

If the servo motor is not waterproof type, you should prevent liquids splash on the motor during installation and operation, especially avoid entry of grease into the motor internal via lead wires or the motor rotor.

Note: If users demand for waterproof type servo motors, please declare in the indent.

2) Temperature and relative humidity

Ambient temperature should be kept between 0 and 40 ℃ (No icing). The motor temperature increases as the operating time last for long, therefore, enforcing heat dissipation should be taken into account if the ambient space is inadequate or other devices also heat the air. The relative humidity should not be higher than 90% and no condensation.

3) Vibration

Avoid vibration for the servo motor installation. Vibration should be less than 0.5G (4.9m/S^2).

4.4.2 Servo motor installation method

1) Way of installation

GK6 motor series can be installed in a horizontal position or a vertical

position.

2) Installation instructions:

- When you assemble or disassemble the belt drive of the motor, do not knock on the motor or rotor to avoid damage to the encoder. And use helical drawing tools for thermal expansion joint assembly and disassembly.
- GK6 motors can't afford overload in the axial and radial direction. Recommendation: Use resilient expansion joint to connect the loads.
- When mounting the motors, you need to use spring plug to fasten the bolts, and thereby avoid loose of drop-out.

Chapter 5 Wiring

Warning
● Wiring and checking personnel must be qualified for this job. ● Wait 5 minutes for wiring and checking after power off to avoid electric shock.

Attention
● Wiring is supposed to be done according to the terminal voltage and polarity to avoid damage to the device and/or personal injuries. ● The high frequency oscillated current flows through the servo motor, and the leakage current will be heavy. Therefore, the servo motor earthing terminal and the servo drive earthing terminal (PE) should be together reliably grounded.

Attention
● When assemble/disassemble the mechanical connection parts of the motor rotor, do not use the hammer to knock on the rotor direclty, otherwise, the motor encoder could be damaged. ● Align the end faces of the motor rotor to the best condition,otherwise, vibration could arise or the motor bearing could be damaged.

5.1 Standard wiring

The external connection of the servo drive depends on the selected control mode.

5.1.1 Position control mode

For standard wiring (a) in the position control mode, see Figure 5.1; for standard wiring (b), applicable to Siemens controller 801, in the position control mode, see Figure 5.2.

5.1.2 Speed and torque control mode

For standard wiring in the speed and torque control mode, see Figure 5.3.

5.1.3 Conductor configuration

1) Mains terminals

- Cross section of the wires for terminal R, S, T, PE, U, V, W ≥ 1.5 mm^2 (AWG14-16).
- Grounding: The cross section of the grounding wires should be as large as possible. The servo drive and motor are supposed to be connected to the PE terminal, and thereby grounded. Grounding resistor <4 Ω .
- Adopt UT1.5-4 cold pressed pre-insulated terminals. Make sure the terminals are tightly connected.
- It is recommended to use 3-phase isolating transformer for power supply, in order to reduce the possibility of electric shock.
- It is recommended to use mains filter before supply to reduce interference.
- Install No Fuse Breaker (NFB) to enable the power shutdown of the external mains in the event of drive fault.

2) Command signals and encoder signals

- Cross section of the wires: Use shielded cables (shielded cables with twisted-pair are recommended). The cross section of the wires 0.12 ≥ mm^2 (AWG24-26). The shielding is supposed to be connected with the PE terminal.
- Cable lengths: The cables should be as short as possible. Control cable length ≤ 10 meters; feedback signal cable lenth ≤ 40 meters.

- Wiring layout: The signal wirings should be kept away from the power cables to prevent the entry of interference.
- Install surge absorbers with inductive components (coils) for related circuits. Freewheeling diodes are antiparallelly connected to the DC coils, and RC absorbed circuits are parallelly connected to the AC coils.

Caution
● U, V, W must be connected to the motor windings exactly in corresponding order. Note that you can not adjust the positions of the three terminals to make the motor run in the reverse direction. This is different from the asynchronous motors. ● Cables and lead wires are supposed to be fixed avoiding the heat sink of the drive and the servo motor. Otherwise, the insulation property could be reduced due to overtemperature. ● There is large-capacity of electrolytic capacitance storing in the servo drive, even after power removal, the voltage supply will remain high for a period of time. Do not touch the servo drive or motor within 5 minutes after power removal.

Figure 5.1Standard wiring (a) in the position control mode

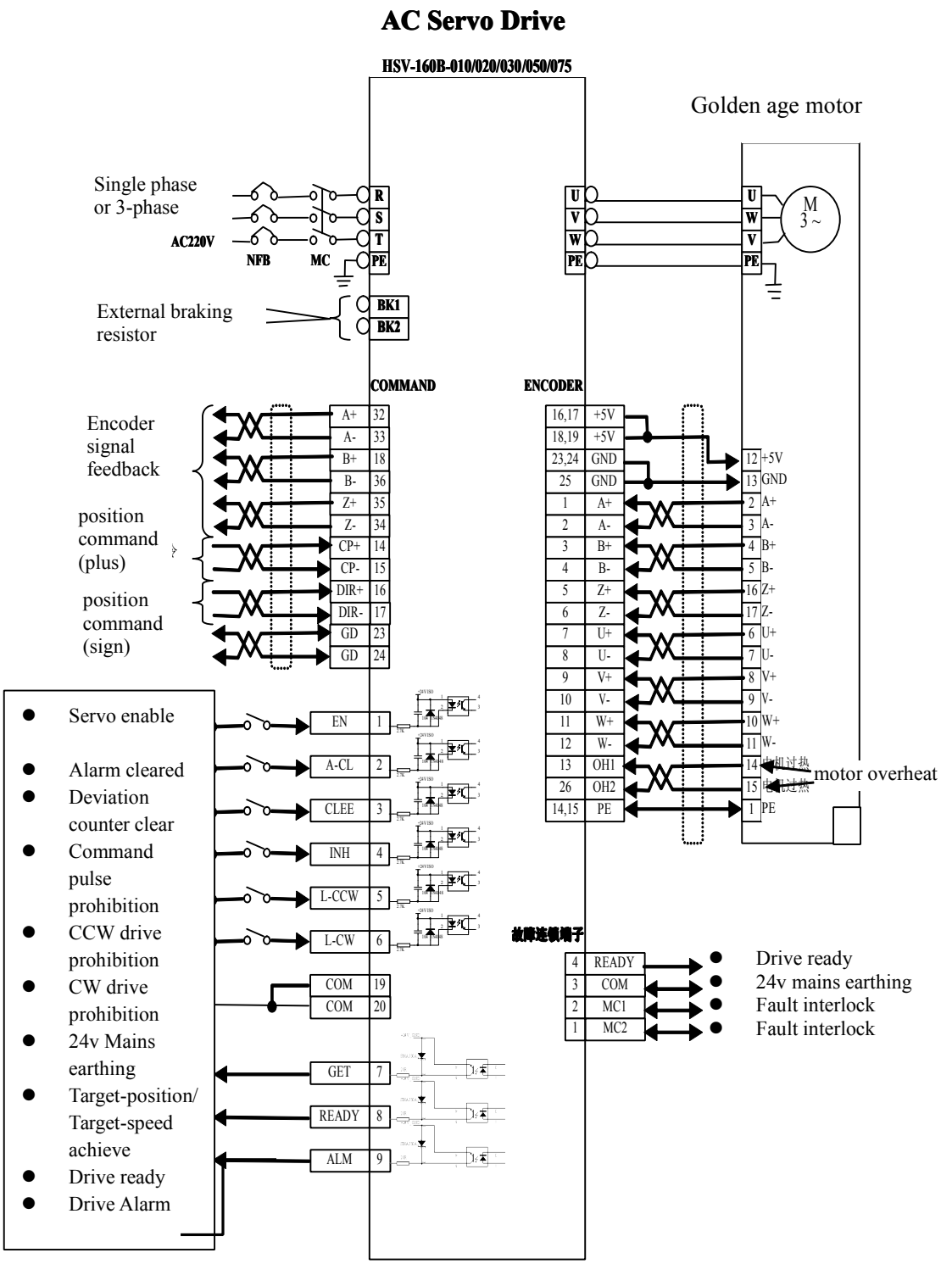


Figure 5.2 Standard wiring (b), applicable to Siemens controller 801

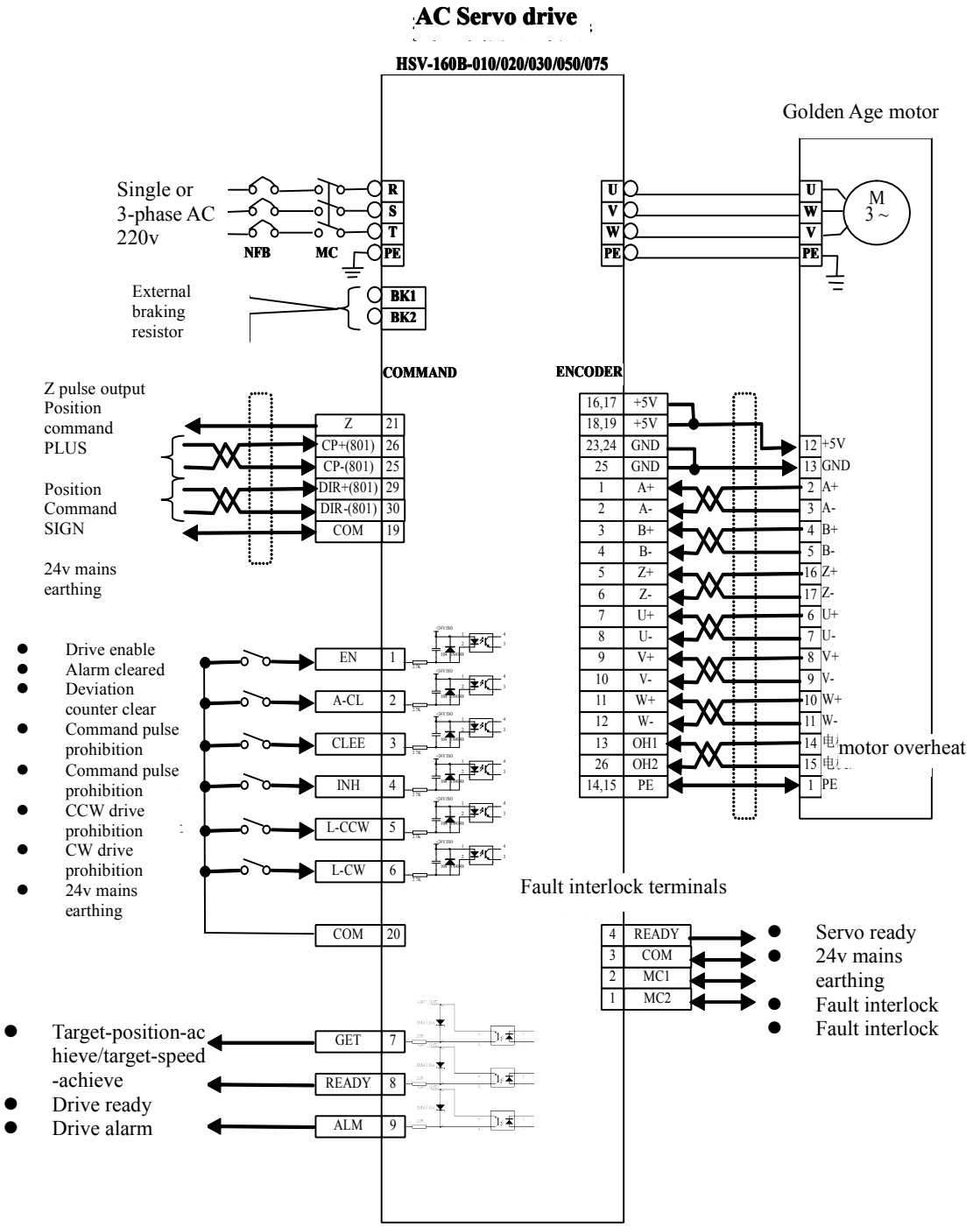
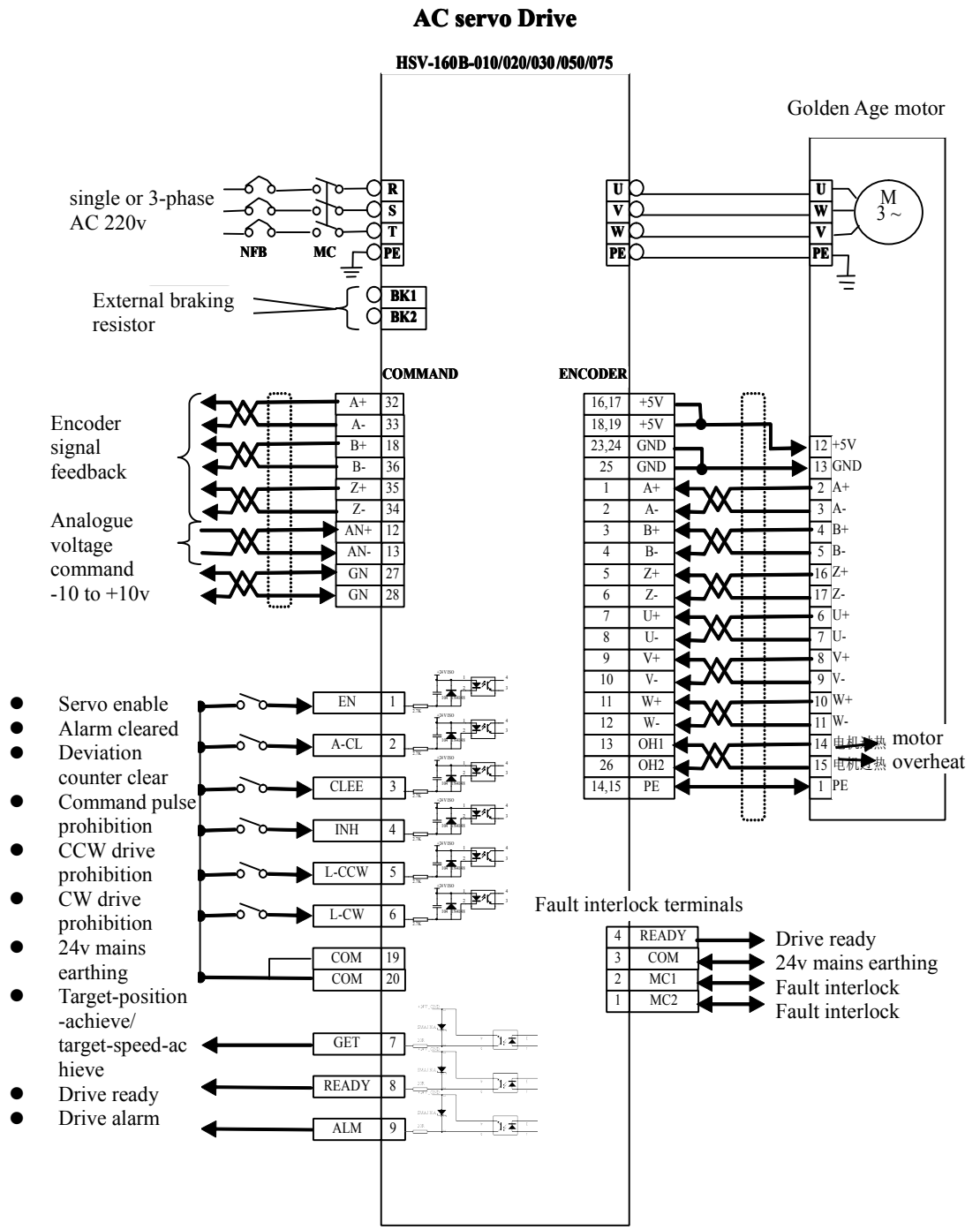


Figure 5.3 Standard wiring in the speed and torque control mode

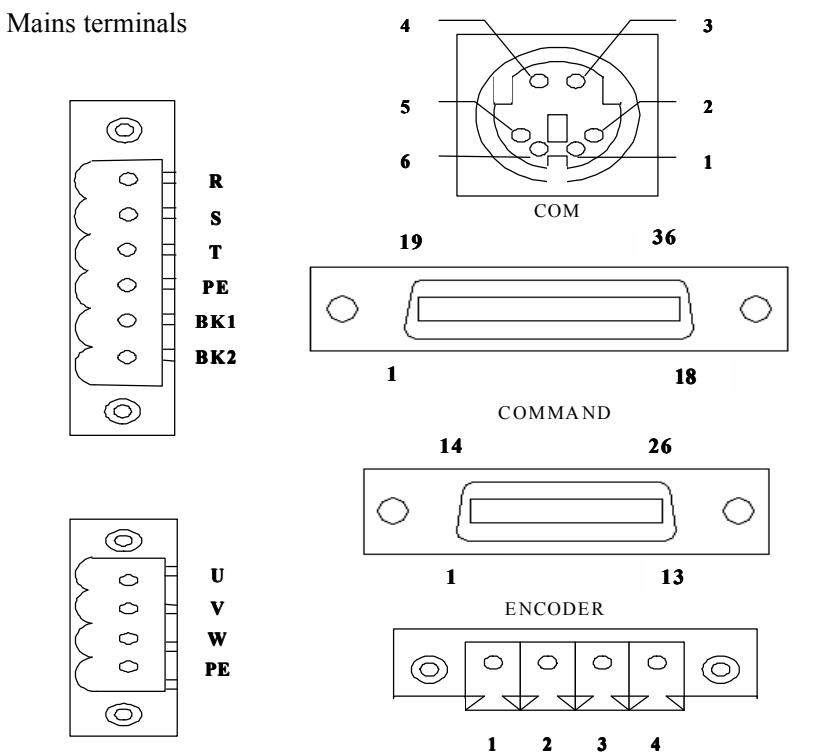


5.2 Signals and functions

5.2.1 HSV-160B+-010/020/030 AC servo drive terminal configuration

Figure 5.4 shows configuration of HSV-160B+-010/020/030 AC servo drive interface terminals, including mains terminals, serial-port communication terminals (COM), signal control socket (Command), encoder interface and fault interlock terminals.

Figure 5.4 HSV-160B+-010/020/030 AC servo drive interface terminal configuration



Fault interlock terminals (The terminal sequence is 1-2-3-4 looking from the external to the internal) after drive installation.

5.2.2 HSV-160B+-050/075 AC servo drive terminal configuration

Figure 5.5 shows HSV-160B+-050/075 servo drive interface terminal configuration, including mains terminals, serial-port communication terminals (COM), control terminals (Command), encoder signal terminals and fault interlock terminals.

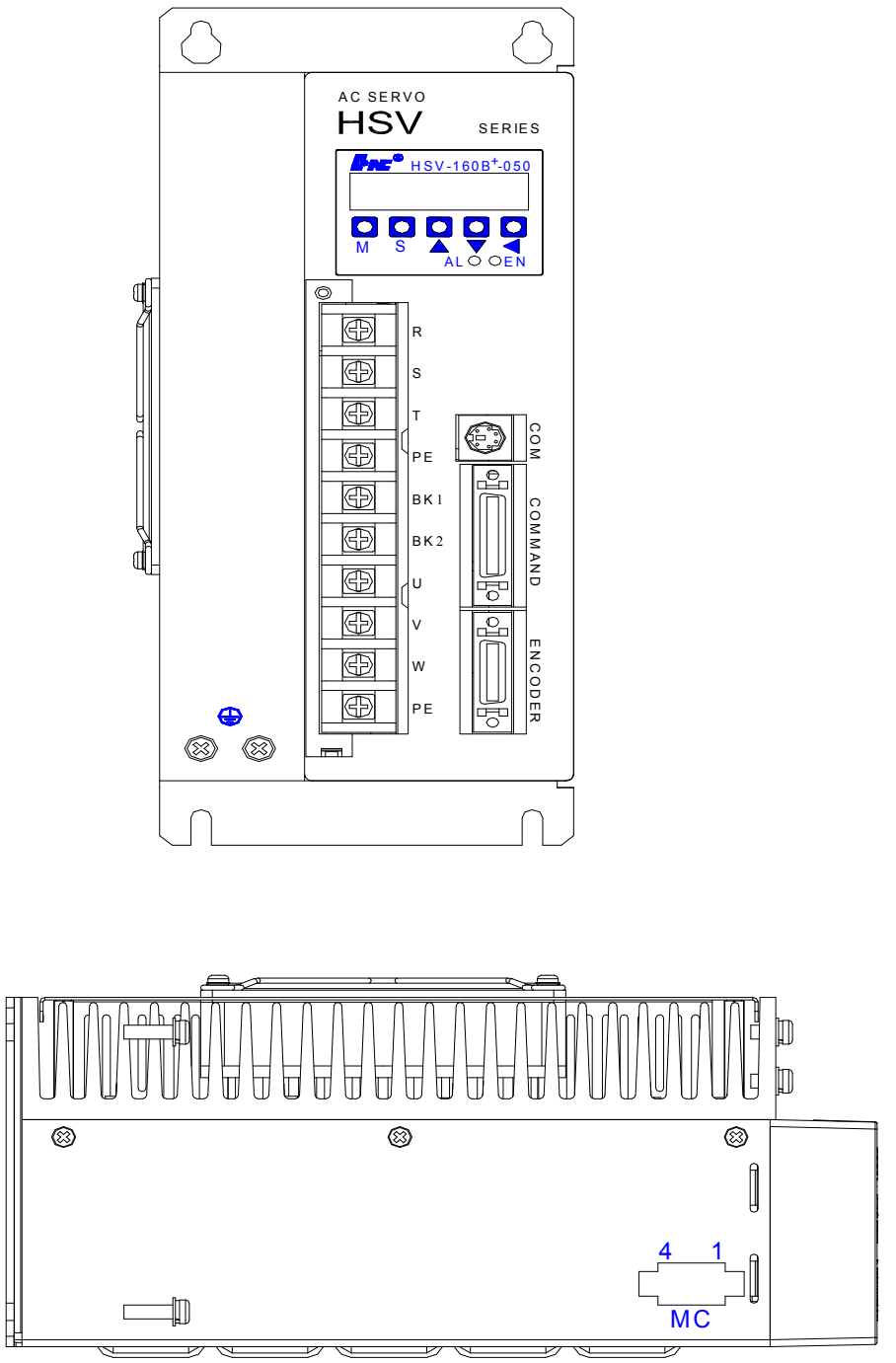
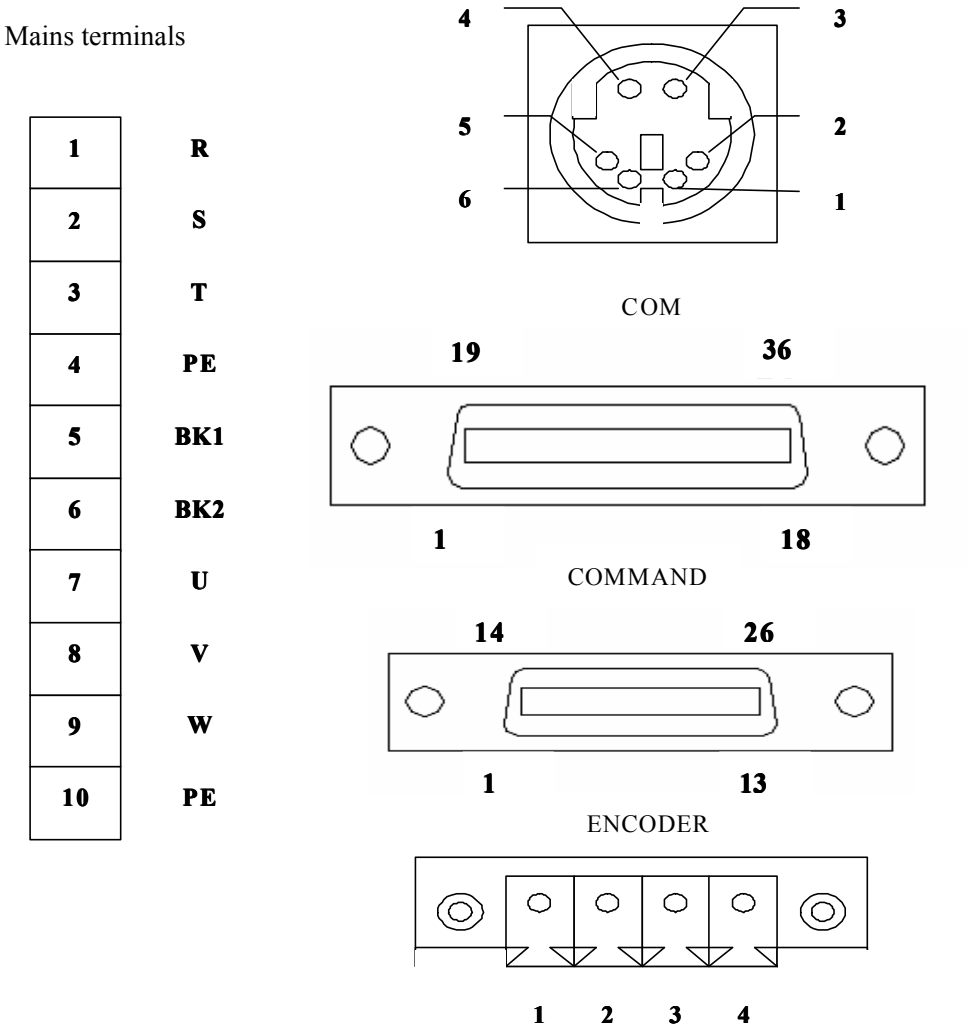


Figure 5.5 HSV-160B^{+}-020/030 AC servo drive interface terminal configuration



Fault interlock terminals (The terminal sequence is 1-2-3-4 looking from the external to the internal after drive installation)

Plugs, lugs and pins of the COMMAND and ENCODER sockets are shown as follows:

Figure 5.6 Lugs and pins of the (Command) control terminals (looking in the face of the lugs)

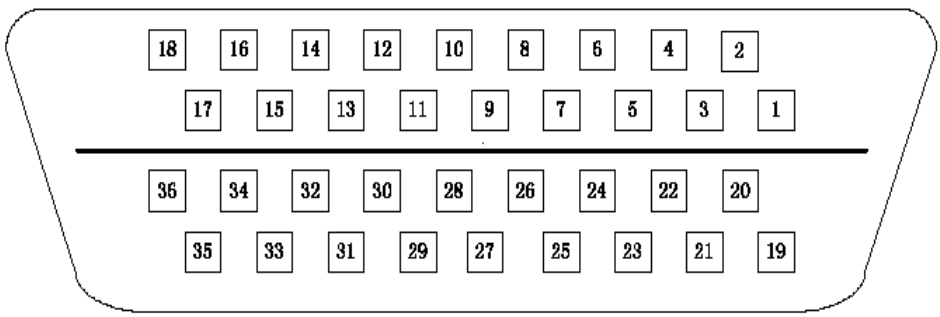


Figure 5.7 Plug of the control terminals (Command) (looking in the face of the plug)

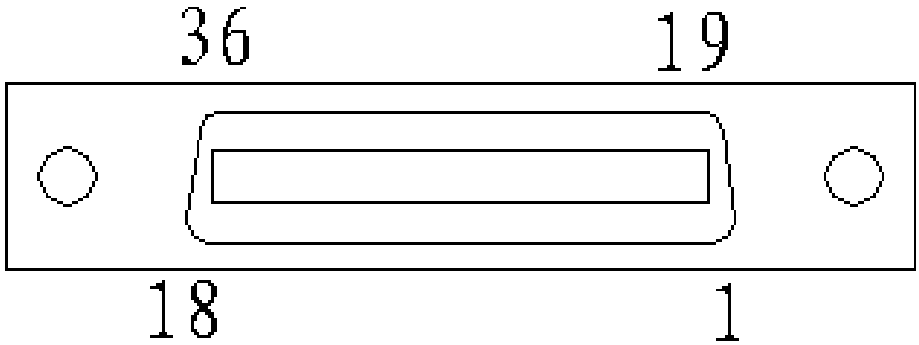


Figure 5.8 Lugs of the encoder socket (looking in the face of the plug)

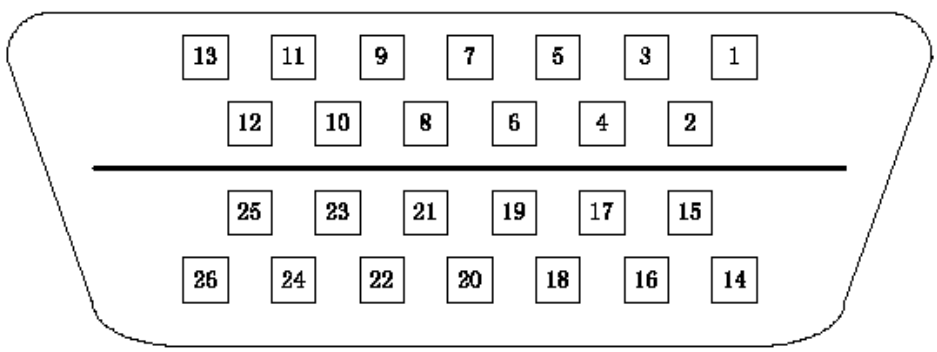
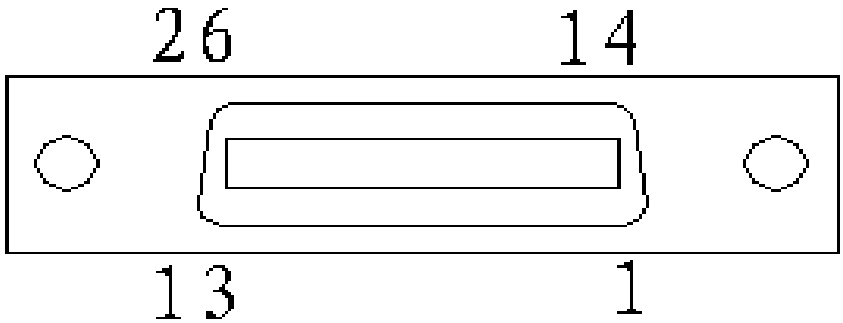


Figure 5.9 Plug of the encoder (looking in the face of the plug)



5.2.3 HSV-160B+-010 AC servo drive mains terminals

Table 5.1 HSV-160B+ -010/020/030 mains terminals

Terminal No.	Terminal Mark	Signal Designation	Decription
1	R	Main circuit power (Single or 3-phase)	Main circuit power input terminal supply: AC220V/50Hz Single phase power supply is not recommended, which only can be used in low power occasions. **Note:Do not connect the mains input terminal with the motor output terminal U, V, W.**
2	S		
3	T		
4	PE	System grounding	Grounding terminal. Grounding resistor <4Ω. Motor output terminal and power input terminal should share one connection point.
5	BK1	External braking resistor	The external and internal braking resistor should be parallelly connected. The internal braking resistance is of HSV160B-030A is 200W 70Ω. For selection and connection of the braking resistors see the Annexure. **Warning: Do not short circuit BK1 and BK2, otherwise, the drive could be burnt.**
6	BK2		

Terminal No.	Terminal Mark	Signal Designation	Description
1	U	Servo motor output	The servo motor output terminals should be connected with the terminal U,V,W correspondingly in the right order.
2	V		
3	W		

4	PE	System grounding	Grounding terminals. Grounding resistance <4 Ω Servo motor output terminal and power input terminal should share one connection point.
		System grounding	Grounding terminals. Grounding resistance <4 Ω Servo motor output terminal and power input terminal should share one connection point.

5.2.4 HSV-160B+ -050/075 mains terminals

Table 5.2 HSV-160B^{+}-050/075 mains terminals

Terminal No.	**Terminal Mark**	**Signal Designation**	**Description**
1	R	Main circuit power (single phase or three-phase)	Main circuit power input terminal supply: AC220V/50Hz Single phase power supply is not recommended, which only can be used in low power occasions. **Note:Do not connect the mains input terminal with the motor output terminal U, V, W.**
2	S		
3	T		
4	PE	Grounding	Grounding terminals. Grounding resistance <4Ω. The servo motor output terminal and power input terminal should share one connection point.

5	BK1	External braking resistance	The external and internal braking resistance are supposed to be connected parallelly. The internal braking resistance is 200w 7Ω. For selection and connection of , see the Annexure. **Warning: Do not short circuit BK1 and BK2, otherwise, the drive could be burnt.**
6	BK2		
7	U	Servo motor output	Servo motor output terminals are supposed to be connected with terminal U, V, W correspondingly in the right order.
8	V		
9	W		
10	PE	Grounding	Grounding terminals. Grounding resistance <4Ω. The servo motor output terminal and power input terminal should share one connection point.
	⏚	Grounding	Grounding terminals. Grounding resistance <4Ω. The servo motor output terminal and power input terminal should share one connection point.

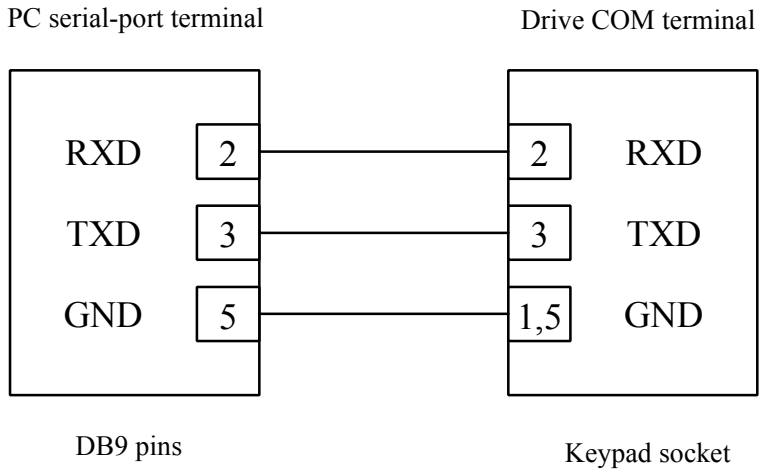
5.2.5 Serial-port communication interface (COM)

Table 5.3 Serial-port communication interface (COM)

Terminal No.	Terminal Mark	Terminal Designation	Description
2	TXD	Datum receive	This terminal should be connected with the controller or PC serial-port TXD to realize serial-port communication.
3	RXD	Datum transmit	This terminal should be connected with the controller or PC serial-port RXD to

			realize serial-port communication.
1, 5	GND	Signal grounding	Data signal grounding

If you want to use serial-port communication function, please contact our after-sale service or development department for the communication softwares. For connection of communication cables, see the drawing below:



5.2.6 Fault interlock terminals

Figure 5.4 Fault interlock terminals

Terminal No.	Terminal Mark	Signal Designation	Description
4	READY	Drive ready for output	Drive ready for terminal output SRDY ON: It indicates that power supply is normal, no alarm occurs, and the drive is ready for the output of signal "ON"; SRDY OFF: It indicates that no power supply is available or alarm occurs, so the drive is ready for the output of signal "OFF".
3	COM	24 V power input	Power supply of the input terminal is used to drive the optical coupler DC 24V, current ≥ 100mA
2	MC1	Fault interlock	Fault interlock output terminals output relay.

1	MC2		Relay connection breaks off in the event of drive fault.

5.2.7 Control Signal terminals (COMMAND)

Table 5.5 Control terminals (COMMAND)

Terminal No.	Terminal Mark	Signal Designation	Description
1*	EN	Drive enable signal	Input terminal of drive enable EN ON: Servo drive operating is permitted. EN OFF: If the servo drive shut off,operating stops, the motor will be in the free state. **Note 1:Before you change the state from EN OFF to EN ON, the motor should be at a standstill.** **Note 2: After tuning to EN ON state, wait at least 50ms to input commands.** **Note 3: You can shield this signal via parameter STA-6 or always keep the switch "ON".**
2*	A-CL	Alarm clear signal	Input terminal of alarm clear ACL ON: System alarm cleared ACL OFF: Hold system alarm
3*	CLEE	Deviation counter clear signal	Input terminal of position deviation counter clear CLEE ON: In the position control mode, position deviation counter clear.
4*	INH	Command pulse prohibition signal	Input terminal of position command pulse prohibition INH ON: Command pulse input prohibition INH OFF: Command pulse input effect
5*	L-CCW	CCW servo drive prohibition signal	Input terminal of L-CCW (counter-clockwise direction) drive prohibition OFF: CCW drive permitted ON: CCW drive prohibited

			Note 1: This signal is used in the event of mechanical limit exceed. In the switch-ON condition, motor torque outputs 0 in CCW direction; **Note 2:You can shield this signal via parameter STA-8 or always keep the switch "OFF".**
6*	L-CW	CW servo drive prohibition signal	Input terminal of L-CW (clock wise direction) drive prohibition OFF: CW drive is permitted ON: CW drive is prohibited **Note 1:This signal is used for mechanical limit exceed. In the switch-ON condition, motor torque outputs 0 in CW direction;** **Note2:You can shield this signal via parameter STA-9 or always keep the switch "OFF".**
7*	GET	Target-position-achieve output signal	Output terminal of Target-position -achieve If the position deviation counter value is within the preset positioning area, the target-position-achieve terminal outputs signal "ON".
		Target-speed-achieve output signal	Output terminal of target-speed -achieve When the target-speed is reached or exceeded, this terminal outputs signal "On".
8*	READY	Drive ready for output signal	Output terminal of drive ready SRDY ON: Power supply is normal, no alarm occurs, and the drive is ready for the output of signal "ON" SRDY OFF: No power supply is available or alarm occurs, so the drive is ready for the output of signal "OFF".

9*	ALM	Drive alarm output signal	Output terminal of drive alarm ALM OFF: When no drive alarm occurs, this terminal will output "OFF". ALM ON: When drive alarm occurs, this terminal will output "ON".
10	Reserved		
11	Reserved		
12	AN+	Analog input positive signal	Analog input command positive.Connect with PC analogue command output terminal
13	AN-	Analog input negative signal	Analog input command negative.
14	CP+	Command pulse input signal (PLUS mode)	Input terminal of external command pulses. **Note 1: Set pulse input mode via parameter PA22** **① Command pulse + Sign mode.** **② CCW/CW command pulse mode.** **③ 2-phase command pulse mode.**
15	CP-		
16	DIR+	Command pulse input signal (SIGN mode)	
17	DIR-		
32	A+	Encoder A+ phase output signal	Servo motor encoder A+ phase output terminal
33	A-	Encoder A- phase output signal	Servo motor encoder A- phase output terminal
18	B+	Encoder B+ phase output signal	Servo motor encoder B+ phase output terminal
36	B-	Encoder B- phase output signal	Servo motor encoder B- phase output terminal
35	Z+	Encoder Z+ phase output signal	Servo motor encoder Z+ phase output terminal

34	Z-	Encoder Z-phase output signal	Servo motor encoder Z-phase output terminal
31			
26	Reserved		
25	Reserved		
29	Reserved		
30	Reserved		
27,28	GN	Analog signal ground	Analog signal ground terminal
23,24	GD	Mains output "-" signal	Control circuit reference ground
21,22	Z	Z pulse output signal	Encoder Z pulse output to Siemens 801 System
19,20	COM	Power input signal ground	Power ground of the input terminal. It is used to drive the optoelectronic coupler of the input terminal. DC24V power ground, current ≥ 100 mA

5.2.8 Encoder signal terminals

Table 5.6 Encoder signal terminals

Terminal No.	**Terminal Mark**	**Signal Designation**	**Description**
1	A+	Encoder A+ input	Connect with servo motor optical encoder A+
2	A-	Encoder A- input	Connect with servo motor photoelectric encoder A-
3	B+	Encoder B+ input	Connect with servo motor photoelectric encoder B+
4	B-	Encoder B- input	Connect with servo motor photoelectric encoder B-
5	Z+	Encoder Z+ input	Connect with servo motor photoelectric encoder Z+
6	Z-	Encoder Z- input	Connect with servo motor photoelectric encoder Z-

7	U+	Encoder U+ input	Connect with servo motor photoelectric encoder U+
8	U-	Encoder U- input	Connect with servo motor photoelectric encoder U-
9	V+	Encoder V+ input	Connect with servo motor photoelectric encoder V+
10	V-	Encoder V- input	Connect with servo motor photoelectric encoder V-
11	W+	Encoder W+ input	Connect with servo motor photoelectric encoder W+
12	W-	Encoder W- input	Connect with servo motor photoelectric encoder W-
13	OH1	Thermal resistor	Servo motor thermal resistor output
26	OH2	Thermal resistor	
20, 21, 22	5V2	Encoder power feedback	Encoder power feedback, the servo drive automatically performs voltage compensation according to the encoder power.
16, 17, 18, 19	+5V	Power output "+"	Servo motor photoelectric encoder uses +5 V power; If the cable is long, you should use multiple cables to connect parallelly
23,24, 25	GND	Power output "-"	
14,15	PE	Shielding layer	Connect with the servo motor external shell

Note:

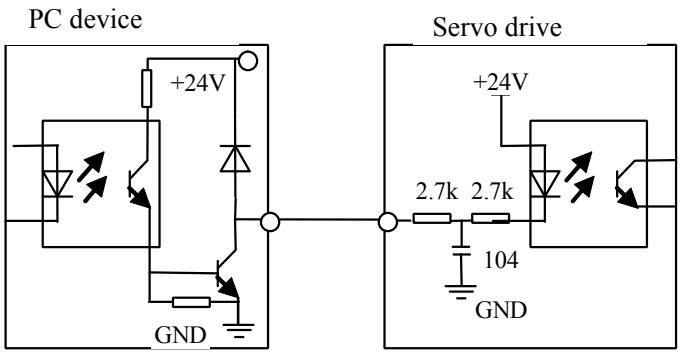
1) Control signal terminals No.1 to No.6 are used to specify input terminal signals. The details can be defined via parameter  to  . Table 5.5 shows the default definition of the terminal signal.
2) Control signal terminals No. 7 to 9 are used to specify terminal output signals. The details can be defined via parameter  to  . Table 5.5 shows the default definition of the terminal signal.
3) You can customize the Input/Output signal of the control signal terminals, either "low level access" or "high level access". If the

corresponding PB parameter is positive, it indicates "low level access"; If it is negative, it indicates " high level access". See ***7.3 Expansion parameter mode*** for details.

5.3 Interface circuit

5.3.1 Switch value input interface

Figure 5.10 Switch value input interface



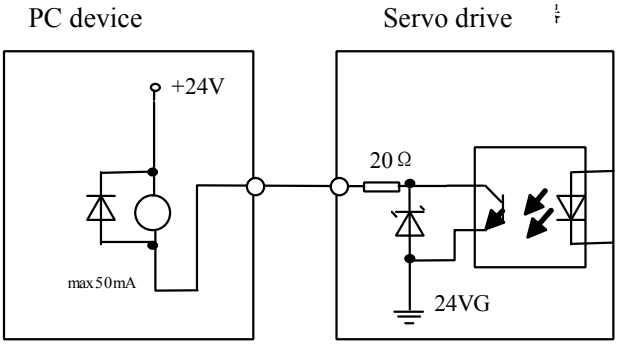
1) Power supply from servo drive internal is DC 24 V, current ≥ 100 mA.

2) Pin 19 and 20 pins of the control terminal should be duly connected with the PC 24 V ground.

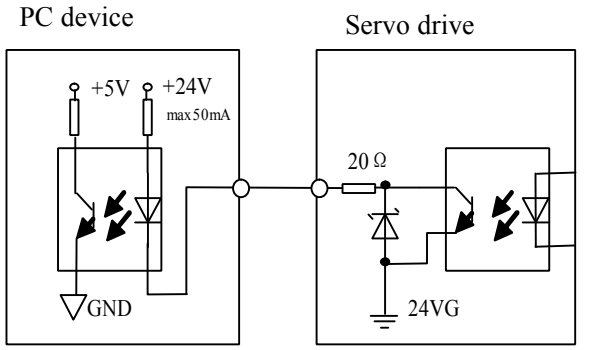
Note: Incorrect connection of 24 V ground will result in the abnormal function of the servo drive.

5.3.2 Switch value output interface

Figure 5.11 Switch value output interface



A: Relay connection



B: Optoelectronic coupler connection

1) The external power supply DC 24V should be provided by users. Note: If you invert the connection of power polarities, the servo drive could be damaged.
2) Output uses open collector circuit form. The max. current is 50 mA and the external power supply is DC 24V. Therefore, switch value output signal load should observe the limit. Exceeding the limit or connecting the output with the mains directly will result in damage of the servo drive.
3) If you use relay like inductive load, the freewheeling diodes should be connected with the load at both ends in inverted parallel. If the freewheeling diodes connect reversely, the servo drive could be damaged.

5.3.3 Pulse array input interface

Figure 5.12 Differential drive mode of pulse input interface

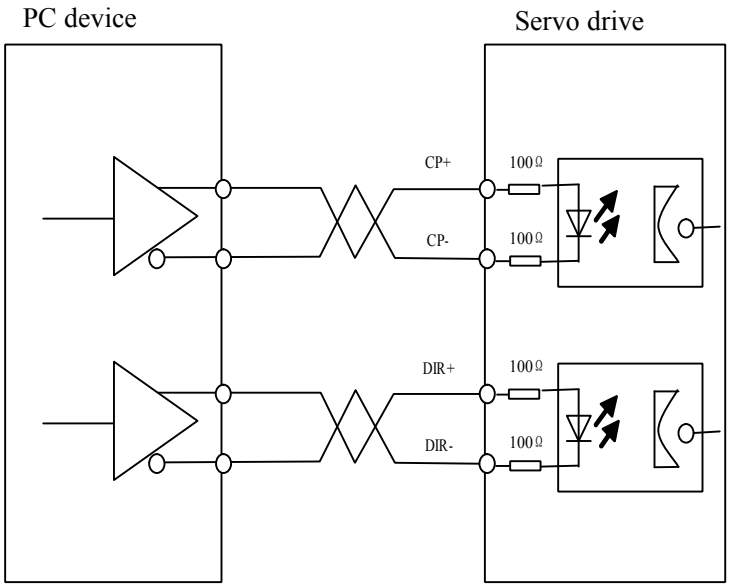
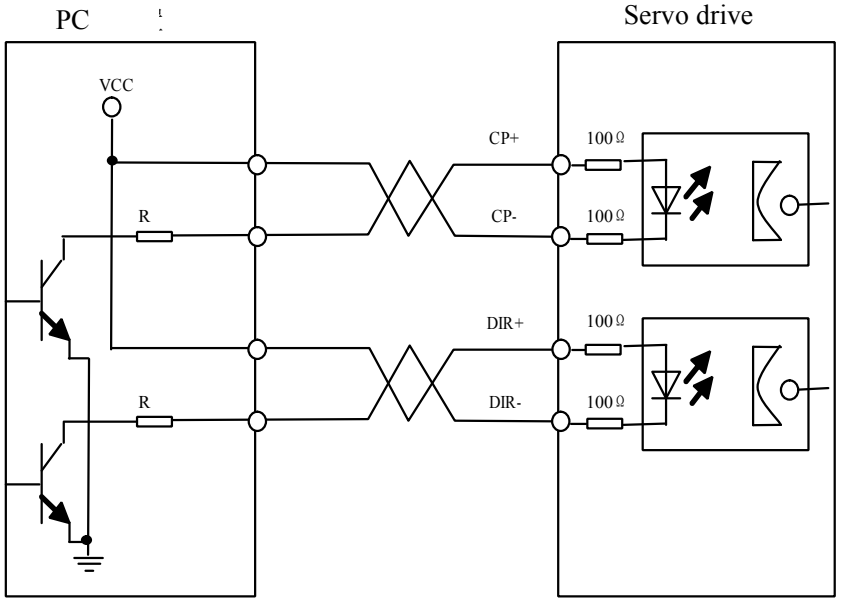


Figure5.13 Single-ended drive mode of pulse input interface



1) In order to send the pulse data correctly, it is suggested to select differential drive mode for the input interface. (especially when the signal wires are long).
2) In the differential drive mode, use AM26LS31 or RS422 line to drive.
3) Single-ended drive mode will lower the action frequency. As pulses input in the circuit, the drive current varies between 10 and 15 mA. The max. external voltage supply should not be greater than 25 V, based on

which, we can calculate the value of the resistance.

Data summarised via our experience (for your reference):

VCC=24 V, R=1.3 to 2 k

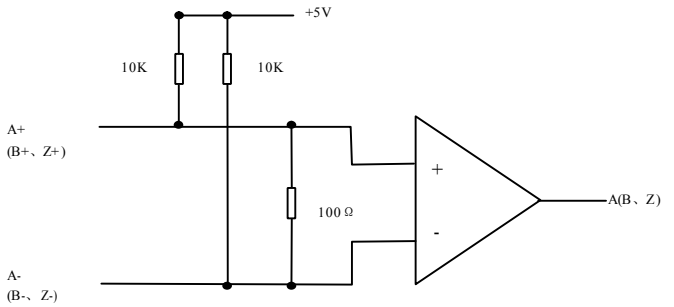
VCC=12V, R=510 to 820Ω

VCC=5V, R=82 to 120Ω

4) Adopt single-ended drive mode, the external power should be provided by the users. Note: If you invert the connection of power polarities, the servo drive could be damaged.

5.3.4 Servo motor photoelectric encoder input interface

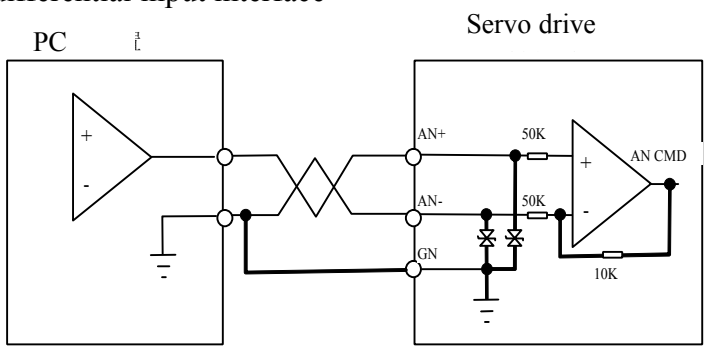
Figure 5.14 Servo motor photoelectric encoder input interface



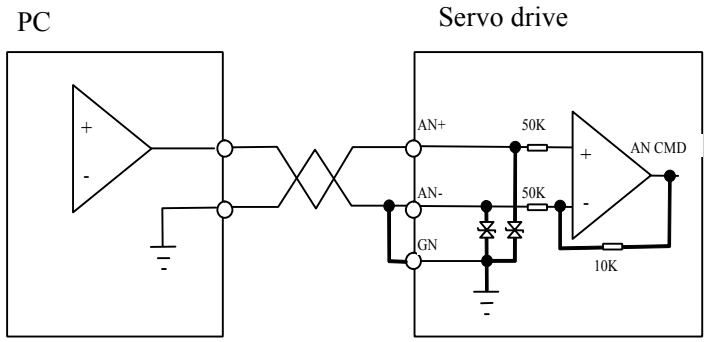
5.3.5 Analog command input interface

Figure 5.15 Analog command input interface

a: Analog differential input interface



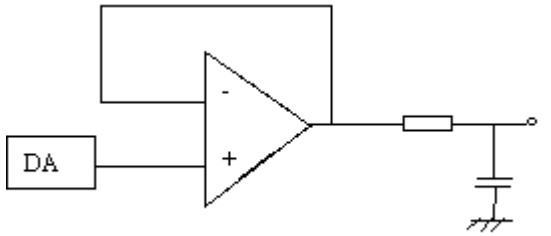
b: Analog single-ended input interface



1) If the analog input interface adopts differential mode, weather to use differential input interface or single-ended input interface depends on the connecting methods. The resistor is 765 KΩ and the input voltage supply range from -10 V to + 10 V or 0 V to + 10V.
2) In the differential connection mode, the analog grounding wire and the input terminal negative should be connected at the controller side. Besides, three wires are required for the connection of controller and the servo drive.
3) In the single-ended mode, the analog grounding wire and the input terminal negative should be connected at the controller side. Besides, two wires are required for the connection of the controller and the servo drive.
4) Differential connection mode excels single-ended connection mode, since it can inhibit interference of common mode.
5) The input voltage supply can not exceed the range: -10 V to +10 V, otherwise, the drive could be damaged.
6) It is suggested to use shielding cables for connection in order to reduce noise interference.
7) Existing of zero drift at the analog input interface is normal, but zero drift compensation can be made via adjusting parameter PA8.
8) The analog interface is not isolated (non-insulated).

5.3.6 Analog command output interface

Figure 5.16 Analog command output interface



5.3.7 Position feedback signal output interface

Figure 5.17 Position feedback signal output interface (a)

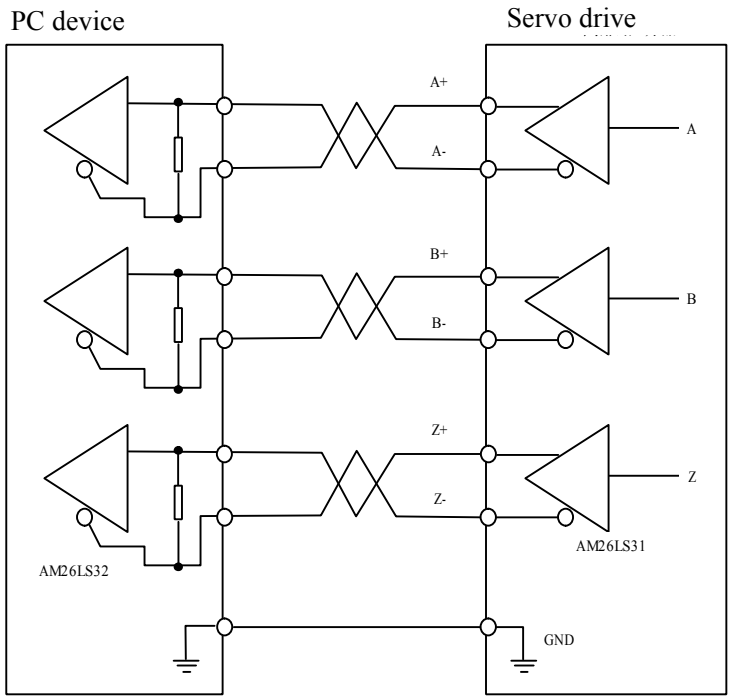
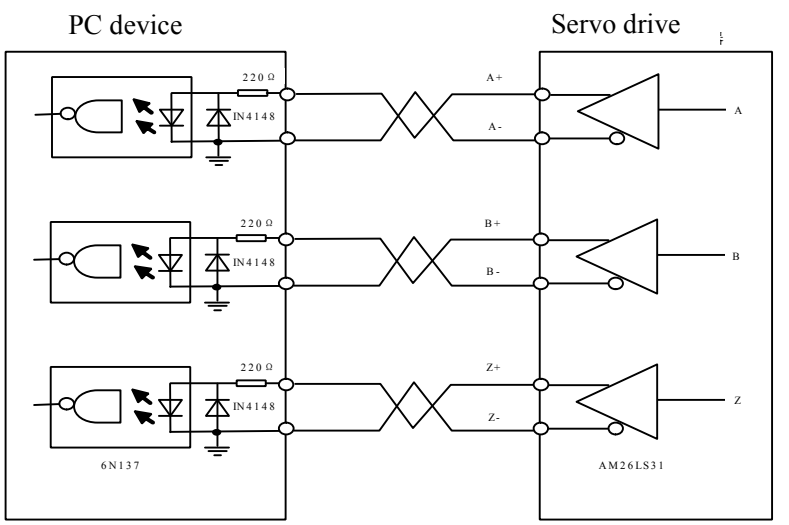


Figure 5.18 Position feedback signal output interface (b)

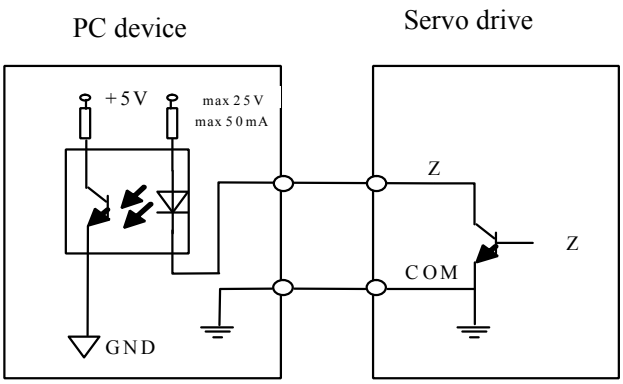


1) Encoder position feedback signals output via differential drive AM26LS31.
2) Controller input interface may use AM26LS32 receiver, which is supposed to be connected with the terminal resistor about 330Ω.
3) The controller grounding wires should be reliably connected with the servo drive grounding wires.
4) Non-isolated output.
5) The controller input interface may also use photoelectric coupler for receipt, however, it is supposed to be the high speed photoelectric coupler like 6N137.

5.3.8 Open collector output interface for the encoder Z-phase signal

6) The encoder Z-phase signal outputs via open collector. When the encoder Z-phase signal arises, it outputs "ON" signal to conduct the access, otherwise, it outputs "OFF" signal to stop the access.
7) Non-isolated output (not insulated).
8) In PC, the width of the Z-phase signal pulse is normally narrow, therefore, you should use high speed photoelectric coupler receiver like 6N137.

Figure 5.19 Open collector output interface for the encoder Z-phase signal

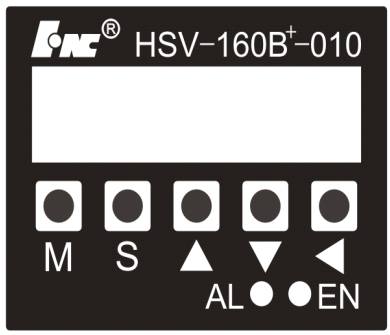


Chapter 6 Operation and Display

6.1 Keypad operation and display

- Figure 6.1 shows the panel.

Figure 6.1 HSV-160B+-010/020/030/50/075A AC Servo drive panel



The drive panel comprises 6 LED segment displays and 5 keys (▲, ▼, ◀, **M**, **S**), which are used to show various status of the system and parameter settings etc. Functions of the keys:

M: Mode changing in the main menu category

S: Entry of the submenu, or return, or input saving

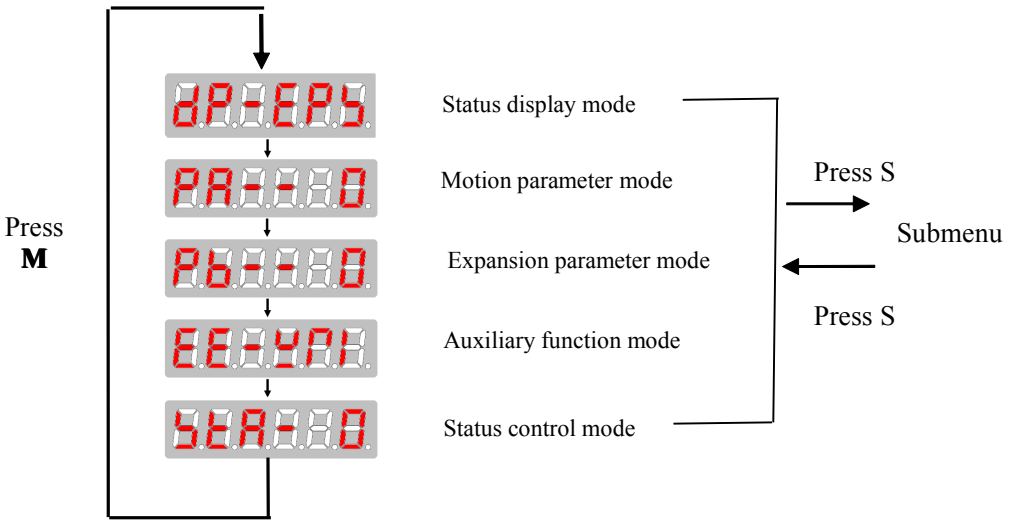
▲: Increase in serial number or value, or forward to the next option

▼: Decrease in serial number or value, or back to the previous option

◀: Replacement

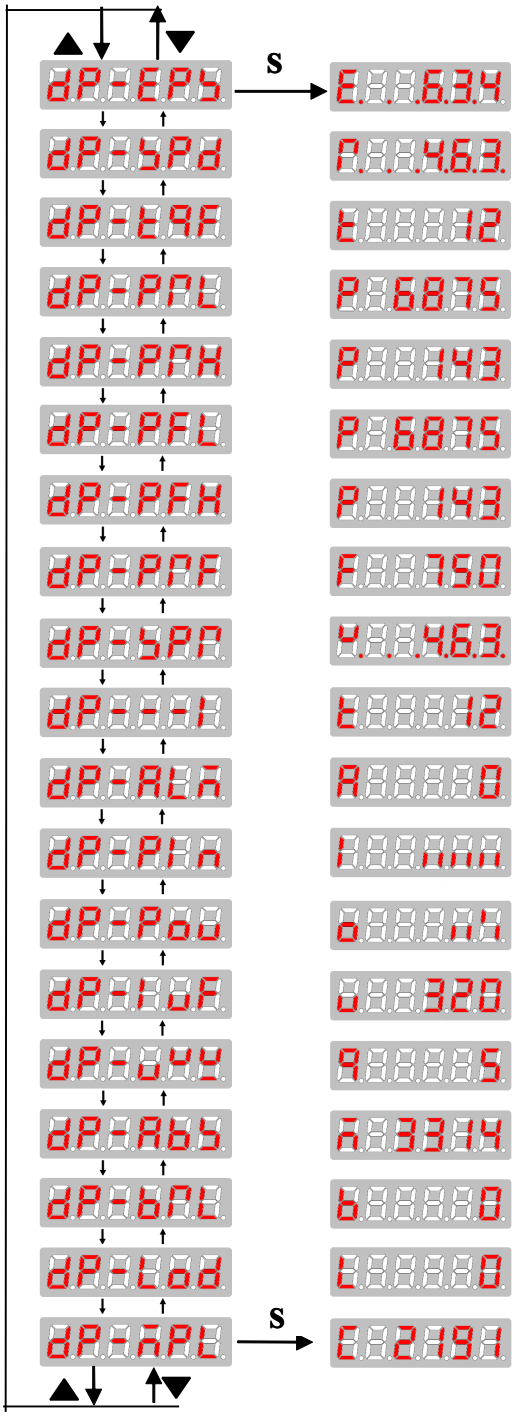
- After connecting the drive power, the 6 LED segment will appear on the display.
- Users are supposed to operate on the multi-level menus. The first-level menu is the main menu which includes five operation modes. In each operation mode, there's a function submenu. Figure 6.2 shows the main menu diagram:

Figure 6.2 HSV-160B+ Series servo drive main menu



- Press **M** to change the operation mode in the main menu. Via pressing ▲, ▼, you can enter the function submenu.
- Select  in the main menu, press ▲, ▼ to enter the display mode. HSV-160B+ AC servo drive has 19 displays (see table 6.1). Users can select the required display usage via pressing ▲, ▼ and then press **S** to observe the status information of the servo drive in the selected display mode. To quit the selected display mode, press **S** again; To return to the main menu, press **M**.

Figure 6.3 Status monitoring mode menu and demonstrations



Position deviation: -634 pulses

Actual speed: -463 r/min

Display of motor torque (Unit: 0.1%)

Target position command pulses: 1436875

Actual feedback position pulses: 1436875

Position command input frequency: 75 Kpps

Target speed command: -463 r/min

Display of motor current: 1.2 A

Alarm code. "0": No alarm reported.

Input interface status

Output interface status

U-phase momentary current feedback

Current position of motor magnetic pole

Motor absolute position mechanical angle

Pumping braking load ratio

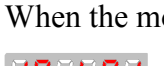
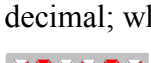
Motor actual load ratio in the past 10s.

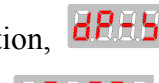
Reserved

Table 6.1 Display modes list

S.N.	Segment Display	Description
1		Display of position tracking error (Unit: pulse)
2		Display of actual speed (Unit: 1r/min)
3		Display of motor torque (Unit: 0.1%)
4		Display of position specified 4 bits (low)
5		Display of position specified 4 bits (high)
6		Display of position feedback 4 bits (low);
7		Display of position feedback 4 bits (high)
8		Display of position command input frequency: (Unit: 0.1 Kpps);
9		Display of speed command (Unit: r /min);
10		Display of motor current (Unit:0.1A);
11		Display of alarm interface status;
12		Display of input interface status;
13		Display of output interface status;
14		Display of U-phase current feedback (Unit: digital, "32767" indicates the max. positive current);
15		Display of motor magnetic pole position;
16		Display of motor absolute position mechanical angle;
17		Display of pumping braking load ratio (Unit: %)
18		Display of motor actual load ratio in the past 10s (Unit: %)
19		Reserved

Note:

1) When the motor operates in the clockwise direction (reverse),  displays decimal; when the motor operates in the counter clockwise direction,  displays integer.

2) If the display of  increases 10000, then the display of

 will increase 1.

3) If the display of  increases 10000, then the display of  will increase 1.

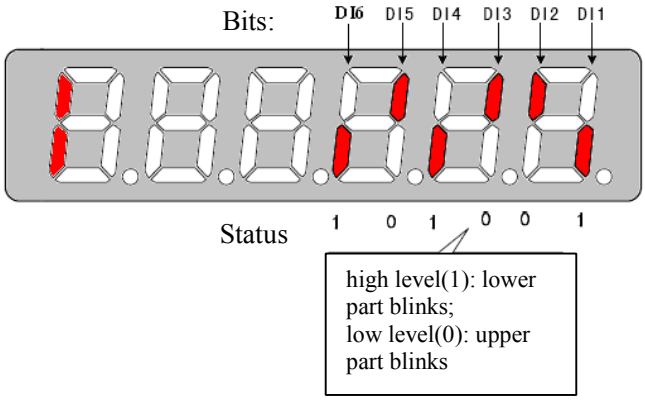
4)  displays the command frequency, unit: 0.1 KPPS. For example, the century star triggers pulses,  displays 840,  value can be calculated by the following formula:
(840 × 0.1 × 1000 × 60) / 10000 = 840 × 0.1 × 6 = 84 × 6 = 504

5)  displays speed command, unit: r/min. For example,  =100,  will display 10 (when  = 0).

6)  displays hardware alarm interface status. When the lamp (alarm indicator) on the panel is red, it means a servo drive hardware alarm is reported. Alarms can be reported via this monitoring display, for example  . After trouble shooting and fault clearance, the servo drive system can be recovered via alarm reset function in the auxiliary mode or servo drive powerdown recovery.

7)  displays the input interface status. It shows the input voltage situations of the 6 pins, DIN1 to DIN6. For example, if the DIN1 input voltage value = 24v (the input optical coupler is disconnect), the corresponding segment displays lower parts blink; If the input voltage value = 0v(the input optical coupler is connected), the corresponding segment displays upper parts blink.

Figure 6.4 Indication of the input interface status

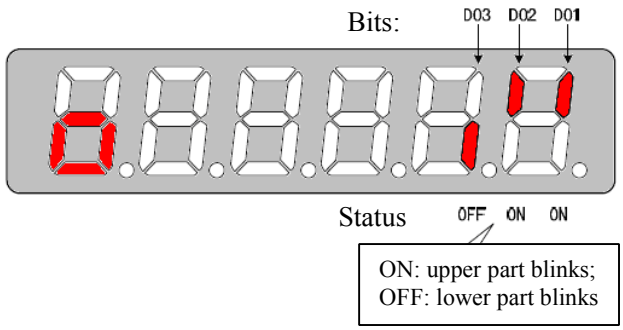


Note:

- High level (1) indicates the voltage value with which the optical coupler cannot be connected. Generally, it is 24v;
- Low level (0) indicates the voltage value with which the optical coupler can be connected. Generally, it is 0v;
- Input of which voltage value can effect the function depends on the value of the 6 parameters, PB.015 to PB.020. If the parameter set values are positive, the function effects when input 0v; If the set parameter set values are negative, the function effects when input 24v.
  As for DIN1 to DIN6 represent which function, it depends on the absolute values of the parameters PB.015 to PB.020.

8) DP.P60 indicates output interface status. When the corresponding output function performs, the upper part of the digital segment displays. Input of which voltage can effect the function depends on the pos. or neg. of the set values of the parameters PB21 to PB23.

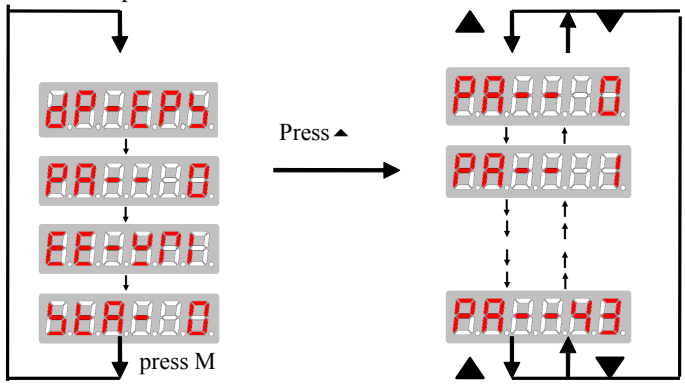
Figure 6.5 Indication of input interface status



9) displays motor magnetic pole position. When the motor operates counter clockwise at low speed, it blinks 3-1-5-4-6-2 sequential numbers in turn; when the motor operates clockwise at low speed, it blinks 2-6-4-5-1-3 invert sequential numbers in turn.

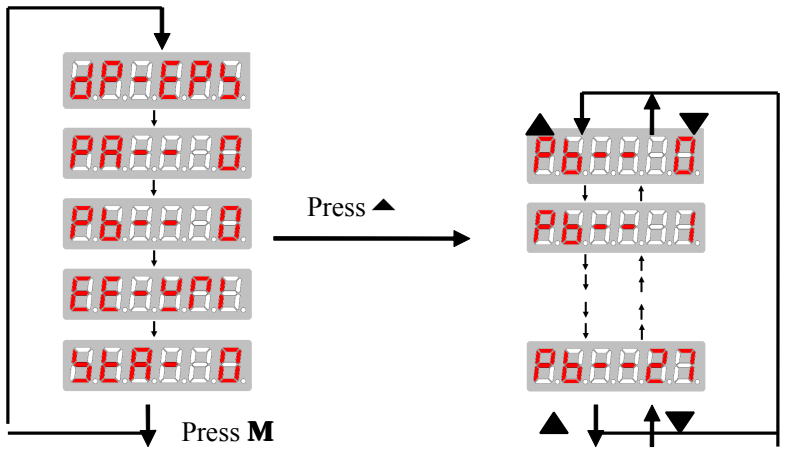
- You can select in the main menu, and then press ▲, ▼ to enter the motion parameter mode. HSV-160B+ AC servo drive has in total 44 motion parameters.

Figure 6.6 Motion parameter mode menu



- Select parameter in the motion parameters and set its value to , and then you may enter expansion parameter mode. HSV-160B+ AC servo drive has 28 expansion parameters (including 2 reserved parameters).

Figure 6.7 I/O parameter setting mode menu



- You can select EE-YAH in the main menu, and then press ▲, ▼ to enter the auxiliary mode. HSV-160B+ has 7 auxiliary operation functions, see Table 6.2)

Figure 6.8 Auxiliary operation mode menu

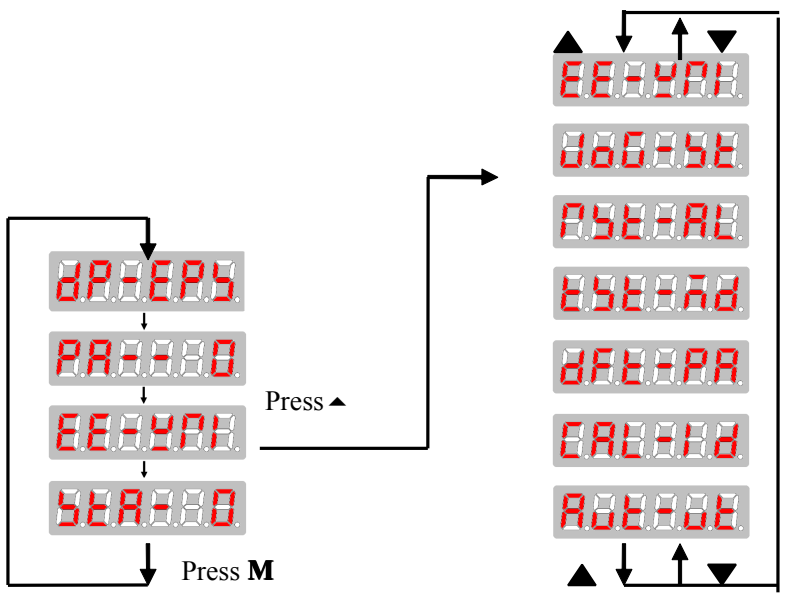


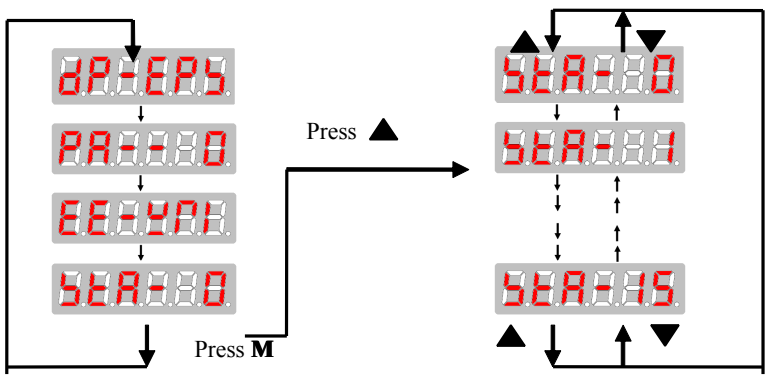
Table 6.2 Auxiliary mode list

Display	Mode	Function
EE-YAH	Control parameter saving	Save the preset drive control parameters to EEPROM
JOG-SE	JOG operation mode	Drive and motor operate at the preset speed in the JOG mode
RSET-AL	Alarm reset mode	Drive reset, clear the history faults

tSt-Ad	Internal testing mode	Drive internal open loop testing (Note: This mode is not applicable to long time operation)
dFt-PA	Parameter defaults recovery	All PA parameters reset to factory default values
CAL-EnC	Calibrate the encoder 0 position	Calibrate the motor encoder 0 position
AUt-tU	Parameter autotuning	Autotuning drive parameters to match with the motor load inertia

- You can select StA-00 in the main menu, and then press ▲, ▼ to enter the control parameter mode. HSV-160B+ AC servo drive has 16 control parameters including 6 reserved parameters.

Figure 6.9 Control parameter mode menu



- 6-bit LED segment displays various status and datum of the servo drive system. When "A" appears at the first bit, it indicates an alarm is reported, and the rest segment indicates the alarm number.

Figure 6.7 Alarm display

- After trouble shooting and fault clearance, the servo drive system can be recovered via alarm reset function in the auxiliary mode or servo drive powerdown recovery.

6.2 Parameter management

Attention
● After parameter revision, you should select "EE-WRI" in the auxiliary mode, and then press **S** to activate the revised parameter. ● Parameter setting takes effect immediately, so wrong setting could

result in unexpected actions of the device or even accidents.

6.2.1. Parameter change and saving

1) Motor and drive code & expansion parameter changing and saving

To change the paramter  and the expansion parameters from  to  , select  in the first layer, and then press ▲, ▼ to select  . Press **S**, the parameter value is displayed. Press ▲, ▼ to change the parameter value. Pressing ▲ or ▼ once, the parameter value changes 1; Keep pressing ▲ or ▼, the parameter value changes continuously. Press ◀, the modifying position moves one bit left (left cycle). When you change the parameter, the LED display right end decimal point is bright. If you set  =  , you can change the value of the parameter  via operating ditto. Press **M** to switch to expansion parameter  , and you can modify expansion parameters via operating ditto; Otherwise, press **S** to return to parameter selection menu without effecting. To save the parameter modification or setting, first you need to input the password  to the parameter  , and then press **M** to switch to  mode. Press **S** to save the modification or set value to the drive EEPROM. After saving complete, the segment displays  ; Or if it fails, the segment displays  . Press **M**, you can switch to other modes; Or press ▲, ▼ to change the motion parameters.

2) Modifying and saving motion parameters

To modify and save the control parameters:  to  ,  to  ,  to  , and control status parameter  to  . First, select  in the first layer, press ▲, ▼ to select the parameter number. Press **S** to view the parameter value. Press ▲、▼ to change the parameter value. Press ▲ or ▼ once, the

parameter value changes 1; Keep pressing ▲ or ▼, the parameter value changes continuously. Press ◀, the modifiying position moves one bit left (left cycle). When you change the parameter, the LED display right end decimal point is bright. And then you can change the parameter via operating ditto. Press **S** to return to the parameter selection menu without effecting. To save the parameter modification or setting, first you need to input the password  to the parameter  , and then press **M** to switch to  mode. Press **S** to save the modification or set value to the drive EEPROM. After saving complete, the segment displays  ; Or if it fails, the segment displays  . Press **M**, you can switch to other modes; Or press ▲, ▼ to change the motion parameters.

6.2.2. Parameter recovery

Press **M** to switch to  mode, select  in the first layer, and press ▲, ▼ to select the parameter  . Press **S**, the segment displays  .The parameter recovery is completed. However, it takes effect only after saving. Press **S** again, and then press **M** to switch to  . Press ▲ or ▼ to select the parameter, and set or change its value. Press **S** to return to the parameter without effecting.

To save the parameter modification or setting, first you need to input the password  to the parameter  , and then press **M** to switch to  mode. Press **S** to save the modification or set value to the drive EEPROM. After saving complete, the segment displays  . Parameter recovery saving is complete. Reconnect the power supply after powerdown, the parameters will recover to defaults. If the saving fails, the segment displays  . Parameter recovery saving fails. Reconnect the power supply after powerdown, the parameters can not recover to defaults.

Parameter defaults depend on the servo motor brands selected. Now we use

Huada servo motors and Golden servo motors. The servo motor brand can be told via the kilobit value of the parameter  . If you use Huada servo motors, the parameters recover to Huada motor parameter defaults; If you use Golden servo motors, the parameters recover to Golden motor parameter defaults.

Chapter 7 Parameter Setting

Attention
● The technical persons who attend parameter adjustment should understand the indications of the parameters. Wrong setting could result in damages and/or injuries. ● Suggestion: After parameter adjustment, first carry out the free-load test run of the motor.

7.1 Function menu

HSV-160 B^+ has various parameters, with which you can adjust or set the drive performance and functions. In this chapter, it describes the usages and functions of various parameters. It is crucial to master the optimal use of the parameters and the operation of the drive.

HSV-160B^+ parameters can be divided into three categories: First, motion parameters; Second, expansion parameters; Third, control parameters. These three categories respectively corresponding to the three parameter modes, namely, motion parameter mode, expansion parameter mode and control parameter mode. And the parameters can be checked, set and adjusted via drive panel keys or computer serial ports.

Table 7.1 Explanation of parameter categorizing

Category	Display	Parameter No.	Brief Description
Motion parameter mode		0 to 43	You can ajust various characteristics, set control operation methods and motor related parameters.
Expansion parameter mode		0 to 23	You can set the second gain, the third gain, and the I/O interface function etc.
Control parameter mode		0 to 15	You can select alarm shielding function or selection methods of internal control function etc.

7.2 Motion parameter mode

HSV-160 B^+ type servo drive has 44 motion parameters (thereof, 1 is

reserved). The definitions are as follows:

- Table 7.2 shows the drive factory defaults when it is in combination with Golden Age motor GK 6060-6 (3 Nm, 2000 rpm). If combined with other motor type, the usage and value of the parameters marked with "*" may be different.
- In the column "control modes applicable": "P" stands for position control mode; "S" stands for speed control mode; "T" stands for torque control mode.

Table 7.2 Motion parameter list

Parameter No.	Name of the Parameter	Control modes applicable	Range of parameter value	Factory defaults	Unit
0	Position loop proportional gain	P	20 to 10000	400*	0.1Hz
1	Position loop feedforward gain	P	0 to 150	0	%
2	Velocity loop proportional gain	P, S	200 to 20000	2500*	
3	Velocity loop integral time constant	P, S	5 to 500	20*	ms
4	Velocity feedback filter factor	P, S	0 to 7	0	
5	Max. torque output value	P, S, T	30 to 500	250	1%
6	Acceleration time constant	P, S	1 to 32000	200	ms
7	Velocity command input gain	S	1 to 9000	2000	
8	Velocity command zero drift compensation	S	-1023 to 1023	0	
9	Torque command input gain	T	1 to 300	200	1%

10	Torque command zero drift compensation	T	-1023 to 1023	0	
11	Range of positioning completion	P	0 to 32767	20	Pulse
12	Range of positioning out-of-tolerance	P	1 to 32767	20000	Pulse
13	Position command pulse numerator frequency	P	1 to 32767	1	
14	Position command pulse denominator frequency	P	1 to 32767	1	
15	Max. torque output value in the positive direction	P, S, T	0 to 500	250	1%
16	Max. torque output value in the negative direction	P, S, T	-500 to 0	-250	1%
17	Max. velocity limit	P, S, T	100 to 12000	2500	1 r/min
18	System overload torque setting	P, S, T	10 to 120	120	0.1 %
19	Software overtemperature time setting	P, S	40 to 32000	4000	1 ms
20	Internal speed	S	-32000 to 32000	0	0.1 r/min
21	JOG mode operation	P, S	0 to 2000	300	1 r/min
22	Position command pulse input method[5)]	P	0 to 2	1	
23	Control method selection[4)]	P, S, T	0 to 3	0	

24	Servo motor magnetic pole logarithm[3)]	P, S, T	1 to 4	3	
25	Encoder resolution[2)]	P, S, T	0 to 3	2	
26	Encoder zero position offset[1)]	P, S, T	-32767 to 32767	150	Pulse
27	Current control proportional gain	P, S	10 to 32767	2500	
28	Current control integral time	P, S	1 to 2047	45	0.1 ms/unit
29	The second position command pulse numerator frequency	P	1 to 32767	1	
30	The third position command pulse numerator frequency	P	1 to 32767	1	
31	Reserved				
32	Torque command filter time constant	P, S	0 to 500	1	0.1 ms
33	Position feedforward filter time constant	P, S	0 to 3000	0	1 ms
34	Software version/user's password	P, S	0 to 2806	100	1. Password for modifying expansion parameters or motor related parameters: 2003. 2. Password for parameter saving: 1230.
35	Position command for smoothing filter time	P	0 to 3000	0	1 ms

36	Communication baud rate		0 to 3	2	
37	Axis address	P, S	1 to 15	1	
38	Deceleration time constant	S	1 to 32000	200	ms
39	The fourth position command pulse numerator frequncy	P	1 to 32767	1	
40	Brake output delay	P, S	10 to 2000	200	Unit: ms
41	Velocity threshold allowed for brake output	P, S	10 to 300	100	Unit: 1rpm
42	Range of target-speed-achieve	P, S	1 to 500	10	Unit: 1rpm
43	Drive type code	P, S	1000 to 2550	2206	Kilobit: "1" indicates "Huada motor"; "2"indicates "Golen Age motor"; Hundred bit: "0" = 10A "1" = 20A "2" = 30A "3" = 50A "4" = 75A "5" = 100A tens place and units order indicate the motor type.

Note:

To enable the parameters marked with 1), 2), 3), 4), 5) after changing, you should save the changes first and then restart. To enable other parameters, you can direct make changes on-line. However, the changes can not be automatically saved.

7.2.1 Elaborate on motion parameter

Table 7.3 Parameter function list

S.N.	Parameter Name	Function	Default	Range of the parameter
0	Position loop proportional gain	① Set position controller proportional gains ② The gain and rigidity increase as the set	400	20 to 10000 Unit:

		value increases, and in the same frequency command pulse condition, the position lag is less. But if the set value is too great, the oscillation or overshooting may arise. ③Parameter values depend on the drive type and load conditions.		0.1 Hz
1	Position loop feedforward gain	①Set position loop feedforward gain. ②When set 100%, it indicates the position lag is zero in any command pulse frequency condition. ③As the position loop feedforward gain increases, the position controller response speed enhances, but the oscillation may occur easily. ④When no fast response characteristic is required, the parameter value is normally set to 0.	0	0 to 150 indicates the range 0 to 150 %
2	Velocity loop proportional gain	①Set the velocity controller proportional gain. ②The gain and rigidity increase as the set value increases. The parameter values depend on the drive system type and load conditions. In general, the set value should increase as the load inertia increases. ③Set a great value as possible, provided no oscillation of the system occurs.	20000	200 to 20000
3	Velocity loop integral time constant	①Set velocity controller integral time constant. ②The integral speed increases as the set value decreases. The parameter values depend on the drive system type and load conditions. In general, the set value should increase as the load inertia increases. ③Set a small value as possible, provided no oscillation of the system occurs.	5	5 to 500 mS
4	Speed feedback filter factor	①Set speed feedback low pass characteristic. ②As the set value increases, the cut-off frequency lowers, and the motor noise decreases. If the load inertia is great, the set value can be duly reduced. If the set value is too great, the response slows down and the oscillation could arise. ③As the set value reduces, the cut-off frequency increases, and the response speed enhances. If high speed response is required, the set value can be duly reduced.	0	0 to 9
5	Max. output torque percentage setting	①Set the internal torque limit of the servo motor. ②The set value is the max. permissible nominal input current of the motor. ③Whensoever, the limit is valid. ④"30 to 500" indicates the set range: 30 % to 500 % of the drive's max. output current. Max. output torque = IRmotor*PA5 Thereof, IRmotor indicates the motor nominal current (expansion parameter PB24). In general, you can select Max. output current = 3*IR. Unit of parameter PA5: 1%.	300	30 to 500

6	Acceleration time constant	①The set value indicates the acceleration time required by the motor to speed up from 0 to 2000 r/min. ②The characteristic of acceleration and deceleration is linear.	200	1 to 32000 ms
7	Velocity command input gain	①Set the relation between analog speed command voltage and rotary speed. The set value indicates the corresponding rotary speed when the voltage supply is +10V. (Unit: 1 r/min) ②It is available only under analog speed input mode.	2000	0 to 9000
8	Velocity command zero drift compensation	In the analog speed control mode, via this parameter, you can adjust the analog speed command input zero drift. Adjusting methods are as follows: ① Shorting the analog control input terminal and the signal ground terminal. ②Set the parameter value to stop the motor.	0	-1023 to 1023
9	Torque command input gain	①Set the relation between analog torque command voltage and the torque. The set value indicates the corresponding torque when the voltage supply is +10 V. ②It is available only in the analog torque input mode. ③"0 to 300" indicates the range: 0 to 300% of the drive's max. ouput current.	200	10 to 300
10	Torque command zero drift compensation	In the torque control mode, use this parameter to adjust the analog torque command input zero drift. The adjusting methods are as follows: ①Shorting the analog control input terminal and the signal ground terminal. ②Set this parameter value to stop the motor.	0	-1024 to 1023
11	Range of positioning completion	①Set pulse range of positioning completion in the position control mode. ②This parameter provides a basis for the drive to judge whether positioning is completed or not in the position control mode. If the remaining pulse quantity displays on the position deviation counter is not greater than the set value, the drive takes it as positioning completed. The positioning complete switch outputs signal "ON"; Otherwise, it outputs signal "OFF". ③In the position control mode, it outputs positioning completion signal.	20	0 to 30000 Pulses
12	Positioning deviation out-of-tolerance detection range	①Set the positioning deviation out-of-tolerance. ②In the position control mode, if the display of the positioning deviation counter excelled this parameter value, the alarm of positioning deviation out-of-tolerance is reported.	20000	1 to 32767 Pulses

13	Position command pulse numerator frequency	①Set the position command pulse fractional-octave-band. (electronic gear) ②In the position control mode, via setting the parameter No.13 and No. 14, the device can be matched with various pulse types, and the optimal control resolution (angle/pulses) can be achieved. ③ P×G=N×C×4 P: Input command pulses; G: Electronic gear ratio G= Frequency division numerator/ frequency division denominator N: Number of turns of the motor C: Photoelectricity encoder winding/round, for this system C=2500 ④ For example, if the input command pulse is 6000, the servo motor rotates per revolution. Set the value of parameter No.13 = 5, and No. 14 = 3. $G=\frac{N\times C\times 4}{P}=\frac{1\times 2500\times 4}{6000}=\frac{5}{3}$ ⑤The recommended range for the electronic gear ratio should be: $\frac{1}{50}\le G\le 50$	1	1 to 32767
14	Position command pulse denominator frequency	① See the parameter No. 13	1	1 to 32767
15	CCW torque limit	①Set the internal torque limit of the servo motor in the CW direction. ②The set value is the max. input current of the servo motor. ③If the set value excels the max. output torque permitted by the system, the actual torque limit should be the max. output torque permitted by the system. ④"0 to 500" corresponds to the range "0 to 500%" of the drive max. output current in the positive direction. CCW torque max. output current = IRmotor*PA15 Thereof, IRmotor indicates the motor nominal current (expansion parameter PB24). In general, the max. output current in the pos. direction = 3 * IRmotor. The unit of the PA15 is 1%.	250	0 to 500
16	CW torque limit	① Set the internal torque limit of the servo motor in the CW direction. ② The set value is the max. input current of the servo motor. ③.If the set value excels the max. output torque permitted by the system, the actual torque limit should be the max. output torque permitted by the system. ④"-500 to 0" corresponds to the range:"-500% to 0" of the max. output current of the servo drive in the negative direction. CW torque max. output current = IRmotor *	-250	-500 to 0

		PA16 Thereof, IRmotor indicates the motor nominal current. In general, the max. output current in the neg. direction = 3 * motor nominal current.		
17	Max. speed limit	① Set the max. speed limit of the servo motor. ② Regardless of the rotatory direction. ③ If the set value is greater than the nominal rotatory speed, the nominal rotary speed will be taken as the actual max. speed limit. Unit: 1 r/min	2500	100 to 12000
18	Overload tolerance	①Set the servo motor torque value for overload protection. ②The set value indicates the long-time overload input current permitted by the motor. ③Whensoever, this limit is valid. ④The set value is the motor nominal torque percentage. Motor max. output torque = IRmotor * PA 18 Thereof, IRmotor indicates the nominal current of the motor. In general, motor max. output torque = 2 * motor nominal current. Unit of PA18 is 1%.	200	10 to 200
19	Software overload time setting	①Set the permissible overload time by the system. ②The set value indicates the quantity counted in one time unit, and the unit of the value is 1 ms, i.e.: the set value=1000, it indicates that overload time permissible is 1s. ③Whensoever, this limit is applicable.	4000	40 to 32000
20	Internal speed	① Internal speed setting. ② In the internal speed control mode, select the internal speed as the speed command. Unit: 0.1 r min	0	-32000 to 32000
21	JOG operation speed	① Set the operation speed in the JOG mode ② Unit: 1 r/min	300	0 to 2000
22	Position command pulse input method	①Set the form of the position command input pulse. ②Select one of the 3 input methods via parameter setting: 0: 2-phase orthogonal pulse input 1: Pulse + direction (P or N) 2: CCW pulses/CW pulses ③ Looking from the axial direction of the motor, CCW is defined as positive direction; ④ Looking from the axial direction of the motor, CW is defined as negative direction.	1	0 to 2
23	Control modes selection	Use this parameter to select the control mode of the servo drive: "0" indicates position control mode. In this mode, the drive can receive position pulse input command; "1" indicates analog speed control mode. In this mode, the drive can receive analog speed command; "2" indicates analog torque control mode. In this mode, the drive can receive analog torque command; "3" indicates internal speed control mode. In this mode, set the digital speed command via	0	0 to 3

		Parameter 20.		
24	Motor magnetic pole logarithm	Set the motor magnetic pole logarithm: 1: the magnetic pole logarithm of the servo motor is 1; 2: the magnetic pole logarithm of the servo motor is 2; 3: the magnetic pole logarithm of the servo motor is 3; 4: the magnetic pole logarithm of the servo motor is 4.	4	1 to 4
25	Encoder resolution	Set the motor photoelectricity windings: 0 indicates the encoder resolution is 1024 pulse/r; 1 indicates the encoder ; resolution is 2000 pulse/r 2 indicates the encoder resolution is 2500 pulse/r; 3 indicates the encoder resolution is 6000 pulse/r.	2	0 to 3
26	Encoder zero position offset	Set encoder zero position offset: For Golden age motor, the set value is 150 For Huada motor, the set value is -1650 "-32767 to 32767" correspond to the angle range "-180 to 180".	150	-32767 to 32767
27	Current control loop proportional gain	①Set the current control loop proportional gain. ②If the current noise is too big whilst the motor operation, the set value can be duly reduced. ③If the set value is too small, the speed response could lag behind.	25000	10 to 32767
28	Current control loop integral time	①Set the current control loop integral time. ②If the current noise is too big whilst the motor operation, the set value could be duly increased. ③If the set value is too big, the speed response could lag behind.	45	1 to 2047
29	The second position command pulse numerator frequency	Set the second position command pulse numerator frequency.	1	1 to 32767
30	The third position command pulse numerator frequency	Set the third position command pulse numerator frequency.	1	1 to 32767
31	Reserved			
32	Torque command filter time constant	①Set the filter time constant in the torque command mode ②As the time constant decreases, the response speed of the controller increases, but it could result in instability and oscillation of the system. ③If low response characteristic is not required,	0	0 to 255 indicates the range 0 to 25.5ms

		this parameter value is normally set to 0.		
33	Position loop feedforward filter time constant	①Set the filter time constant of the position loop feedforward. ②As the time constant decreases, the response speed of the controller increases, but it could result in instability and oscillation of the system. ③If low response characteristic is not required, this parameter value is normally set to 4.	0	0 to 255 indicates the range 0 to 25.5ms
34	Software version/user's password	Display of default software version; For parameter saving, the password is 1230 For checking and changing PB expansion parameters and the servo motor type, the password is 2003	100	0 to 2806
35	Position command smoothing filter time	①Set the filter time constant in the position command mode. ②As the filter time constant decreases, response speed of the controller increases. ③As the filter time constant increases, response speed of the controller slows down.	0	0 to 3000
36	Communication baud rate	Set the communication baud rate: 0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps	2	0 to 3
37	Axis address	Set the axis address	1	1 to 15
38	Deceleration time constant	①The set value indicates the deceleration time required by the motor to reduce the speed from 2000 to 0 r/min. ②The characteristic of acceleration and deceleration is linear.	200	1 to 32000 ms
39	The fourth position command pulse numerator frequency	Set the fourth position command pulse numerator frequency.	1	1 to 32767
40	Brake output delay	Output brake time delay after the drive shut down.	200	10 to 2000 ms
41	Speed threshold permitted for brake output	Brake activates when the actual value is under the set value.	100	10 to 300 rpm
42	Range of target-speed-achieve	①Set the target speed. ②In the speed control mode, if the actual motor speed is lower than the set value, the target-speed-achieve switch outputs signal "On"; Otherwise, it outputs signal "OFF". ③In the position control mode, this parameter is invalid. ④This parameter is regardless of rotary direction. Unit: 1 r/min	10	1 to 500 rpm

43	Drive type code	Kilobit indicates the motor brand / Hundred bit indicates the drive type / Tens place and unit bit indicates the motor size 1 Huada 0:10A 2 Golden Age 1:20A 2:30A 3:50A 4:75A 5:100A For example.: 110ST-M06020LFBindicates Huada motor configuring HSV-160B+-30A AC servo drive, set the parameter PA-43 = 1206 ("06"for Huada motor). GK6083-6AC31 Golden Age motor configuring HSV-160B+-50A AC servo drive, set the parameter PA-43 = 2411 ("11" for Golden Age motor). For the servo motor type, see the table 7.4, and table 7.5. Note: To change the drive type code and the motor related parameters, first, you need to set PA34 = 2003. To save the changes, set the PA34 = 1230.	1206	Digit on kilobit: 1: Huada Motor 2：Golden Motor The digit on the hundred: 0: 10A 1: 20A 2: 30A 3: 50A 4: 75A 5: 100A the digit on the unit order and tens place indicates the servo motor type

Table 7.4 Code parameter list for Huada motors

Huada Motor Type (1)	**Rated Torque (Nm)**	**Rated Speed (Rpm)**	**Rated Current (A)**	**Motor Code**	**Servo drive code configurable**	**P43 matching code setting (Recommended combination)**
110ST-M02030LFB	2.0	3000	4.0	03	1（20A）	1103
110ST-M04030LFB	4.0	3000	5.0	04		1204
110ST-M05030LFB	5.0	3000	6.0	05		1205
110ST-M06020LFB	6.0	2000	6.0	06		1206
110ST-M06030LFB	6.0	3000	8.0	07	2	1207
130ST-M04025LFB	4.0	2500	4.0	08	(30A)	1208
130ST-M05020LFB	5.0	2000	5.0	09		1209
130ST-M05025LFB	5.0	2500	5.0	10		1210
130ST-M06025LFB	6.0	2500	6.0	11		1211
130ST-M07720LFB	7.7	2000	6.0	12		1212
130ST-M07725LFB	7.7	2500	7.5	13		1313
130ST-M07730LFB	7.7	3000	9.0	14		1314
130ST-M10015LFB	10	1500	6.0	15	3	1315
130ST-M10025LFB	10	2500	10.0	16	(50A)	1316
130ST-M15015LFB	15	1500	9.5	17		1317
130ST-M15025LFB	15	2500	17.0	18		1418
150ST-M15025LFB	15	2500	16.5	19		1419
150ST-M18020LFB	18	2000	16.5	20	4	1420
150ST-M23020LFB	23	2000	20.5	21	(75A)	1421
150ST-M27020LFB	27	2000	20.5	22		1422

Table 7.5 Code parameter list for Golden motors

Golden Motor Type (2)	Static torque (Nm)	Rated speed (Rpm)	Phase current (A)	Motor code	Servo drive code configurable	P43 matching code setting (Recommended combination)
GK6023-8AF31	0.8	3000	1.8	00	0 （10A）	2000
GK6025-8AF31	1.6	3000	3.6	01	1 （20A）	2101
GK6031-8AF31	3.2	3000	4.7	02		2102
GK6032-8AF31-	4.3	3000	6.3	03	2 （30A）	2203
GK6042-6AC31	3.2	2000	3.0	04		2204
GK6064-6AC31	4.5	2000	3.7	05		2205
GK6061-6AC31	6	2000	5.5	06		2206
GK6062-6AC31	7.5	2000	6.2	07		2207
GK6063-6AC31	11	2000	9.0	08	3 （50A）	2308
GK6080-6AC31	16	2000	16	09		2309
GK6081-6AC31	21	2000	20	10	4 （75A）	2310
GK6083-6AC31	27	2000	26.5	11		2411
GK6085-6AA31	33	1200	19.8	12		2412
GK6087-6AA31	37	1200	22.2	13		2413
GK6089-6AA31	42	1200	25.2	14		2414

7.3 **Expansion parameter mode**

- Select the parameter  in the motion parameter mode, set  =  to enter the expansion parameter mode;
- HSV-160B^{+} has 28 expansion parameters, and thereof, 3 are reserved.

Table 7.7 Expansion parameter list

S. N.	Parameter designation	Control modes applicable	Range of the parameters	Factory default	Unit
0	The second position proportional gain	P	20 to 10000	400*	0.1Hz
1	The second speed proportional gain	P, S	200 to 25000	2000*	
2	The second speed integral time constant	P, S	1 to 500	20*	ms
3	The second torque command filter time constant	P, S	0 to 500	0	0.1ms
4*	Gain changeover condition	P	0 to 5	0	0： Fixed first gain; 1: Fixed second gain 2： Switch control changeover 3： Command frequency control 4：

					Deviation pulse control 5： Motor rotary speed control
5	Gain threshold changeover	P	0 to 10000	10	Command frequency:0.1Kpps/ unit; pulse deviation Motor rotary speed: 1 rpm
6	Hysteresis band width of the gain changeover	P	1 to 10000	5	Unit ditto
7*	Hysteresis time of the gain changeover	P	0 to 10000ms	2	ms
8*	Hysteresis time for position gain shift	P	0 to 1000ms	5	ms
9	Checking range when the output speed is 0	P, S	1 to 100	10	1 rpm
10*	Motor powerdown delay after the enable turned off.	P, S	0 to 3000	0	Unit: ms
11	Starting speed of the weak magnetic field		1000 to 4500	1800	1 r/m
12	Torque inertia ratio		100 to 20000	1253	
13	load inertia ratio	P, S	10 to 400	10	Unit: Nm/Kgm2
14	Norm current of the weak magnetic		100 to 2000	800	0.1 %
15	Digital input function I1	P, S	-12 to +12	1	
16	Digital input function I2	P, S	-12 to +12	2	
17	Digital input function I3	P, S	-12 to +12	3	
18	Digital input function I4	P, S	-12 to +12	4	
19	Digital input function I5	P, S	-12 to +12	-5	
20	Digital input function I6	P, S	-12 to +12	-6	
21	Digital input function O1	P, S	-9 to +9	5	
22	Digital input function O2	P, S	-9 to +9	2	
23	Digital input function O3	P, S	-9 to +9	3	
24	Motor nominal current	P, S, T		550	0.01 A
25	Motor nominal rotary speed	P, S, T		2000	1 r/min
26	Motor rotatory inertia	P, S, T		870	10-6 Kgm2
27	Motor nominal	P, S, T		600	0.01 Nm

	torque				

- To effect the gain changeover function of the parameter Pb-04, you should set STA-04 = 1. The mapping relation is listed below:

"0 "is defined as the first gain.

"1" is defined as the second gain.

"2" is defined as switch control changeover.

The mapping of the corresponding switch value input, for example, set Pb-13 = 8, if this switch value is effective, after setting delay time via parameter Pb-07, the gain value will shift from the first gain value to the second gain value, and vice versa.

"3" is defined as command frequency control.

When dP-PFA ≥ (Pb-05 + Pb-06), after setting the delay time via prameter Pb-07, the gain value will shift from the first gain value to the second gain value;

When dP-PFA < (Pb-05 - Pb-06), after setting the delay time via the parameter Pb-07, the gain value will shift from the first gain value to the second gain value;

"4" is defined as deviation pulse control

When dP-EPS ≥ (Pb-05 + Pb-06), after setting the delay time via the prameter Pb-07, the gain value will shift from the second gain value to the first gain value;

When dP-EPS < (Pb-05 - Pb-06),after setting the delay time via the parameter Pb-07, the gain value will shift from the second gain value to the first gain value;

"5" is defined as motor rotary speed control

When dP-SPd ≥ (Pb-05 + Pb-06), after setting the delay time via the parameter Pb-07, the gain value will shift from the first gain value to the second gain value;

When dP-SPd < (Pb-005 - Pb-006)after setting the delay time via the parameter Pb-007, the gain value will shift from the second gain value to the first gain value;

- Pb-005 indicates the gain changeover threshold
- Pb-006 indicates the hysteresis band width of gain changeover

The meanings of the above-mentioned 2 parameters are influenced by the set value of the parameter Pb-004. When set the parameter Pb-004 = "3", "4", "5" respectively, these 2 parameters indicate "command frequency", "deviation pulse" and "motor speed" correspondingly.

- Parameter Pb-007 indicates the gain changeover lag time or the duration between gain changeover preparation ready and changeover starts;
- Parameter Pb-008 indicates position loop gain changeover delay function. Via this parameter, you can set a first-order low pass filter for position loop gain at the time of gain changeover. The gain value will not shift abruptly from parameter PA to PB, instead, after calculation of the slope based on this parameter, and step by step converting to another set of parameters (For calculating changeover step length);
- Parameter Pb-010 indicates motor powerdown delay after the enable is turned off, or PWM close time delay after enable is turned off. Note that this parameter is not applicable when the enable is turned off due to the alarm.

Input function mapping relations:

Input Pin	Mapping parameter	Function
DIN1	Pb-015	If the parameter set value is positive, it functions when input 0v; If the parameter set value is negative, it functions when input 24v. 0: Input invalid 1: Drive enable 2: Alarm clear
DIN2	Pb-016	
DIN3	Pb-017	
DIN4	Pb-018	
DIN5	Pb-019	

DIN6		3: Deviation clear 4: Pulse prohibition 5: Over travel in the positive direction 6: Over travel in the opposite direction 7: Zero speed hold 8: Gain shift switch 9: Electronic gear changeover switch 0 10: Electronic gear changeover switch 1 11: Torque limit in the positive direction 12: Torque limit in the negative direction

In the parameter  to  , if the set values (absolute values) of 2 parameters are the same, the parameter with a larger serial number takes the priority. However, you'd better avoid setting the same values to the parameters  to  .

Output function mapping relations:

Output pin	Mapping parameter	Remark
DOUT1		If the parameter set value is positive, it functions when input 0v; If the parameter set value is negative, it functions when input 24v. 0: Invalid 1: Force effective 2: Servo ready 3: Alarm output 4: Reaching zero speed 5: Positioning completed 6: Reaching the set speed 7: Under torque limit 8: Electromagnetic brake output 9: Zero speed hold
DOUT 2		
DOUT 3		

Of these three parameters  to  , if the set values of 2 parameters are the same, and the functions of the corresponding pins are the same.

7.4 Control parameter mode

Table 7.7 Control parameter list

Parameter Designation	Function	Default value	Explanation
	Reserved	0	

	Position command pulse direction or speed command input in the reverse direction	0	0: Normal 1: Opposite direction
	Whether it allows response off alarm.	0	0: Allow 1: Not allow
	Whether it allows system overspeed alarm.	0	0: Allow 1: Not allow
	Whether it allows over position tolerance alarm.	0	0: Allow 1: Not allow
	Whether it allows software overtemperature alarm.	0	0: Allow 1: Not allow
	Whether it allows start of SVR-ON control from the internal system.	0	1: Allow 0: Not allow
	Whether it allows main power under voltage alarm.	0	0: Allow 1: Not allow
	Whether it allows switch input of over travel in the positive direction.	0	0: Not allow 1: Allow
	Whether it allows switch input of over travel in the negative direction.	0	0: Not allow 1: Allow
	Whether it allows positive and negative torque limit	0	0: Not allow 1: Allow
	Allow weak magnetic field control.	0	0: Use no weak magnetic field control 1: Use weak magnetic control
	Whether it allows servo motor overheat alarm.	1	0: Allow 1: Not allow
	Dynamic switch selection of electronic gear ratio.	0	0:Not allow dynamic switch selection of electronic gear ratio 1: Allow dynamic switch selection of electronic gear ratio
	Gain changeover enable	0	0: Not allow gain changeover 1: Allow gain changeover
	Speed low pass filter	0	0: Use the first-order low pass filter 1: Use the second-order low pass filter

Chapter 8 Operation Tuning

Attention
● The servo drive and motor are supposed to be reliably grounded. PE terminal should be reliably connected with the grounding terminal of the equipment. ● It is suggested that servo drive power be supplied via isolation transformer or power filter to ensure safety and avoid interference. ● The wirings must be checked and confirmed before power connection. ● An emergency stop circuit must be set to enable immediate power removal in the event of malfunctions. ● If the malfunction alarm is reported, before restart, you need to confirm that the error is eliminated and the drive enable input signal is disabled. ● Do not touch the servo drive or motor within 5 minutes after power removal, otherwise, it could result in electric shock. ● Be cautious to prevent burnt, since the temperature may go up after the servo drive and motor operate for a period of time.

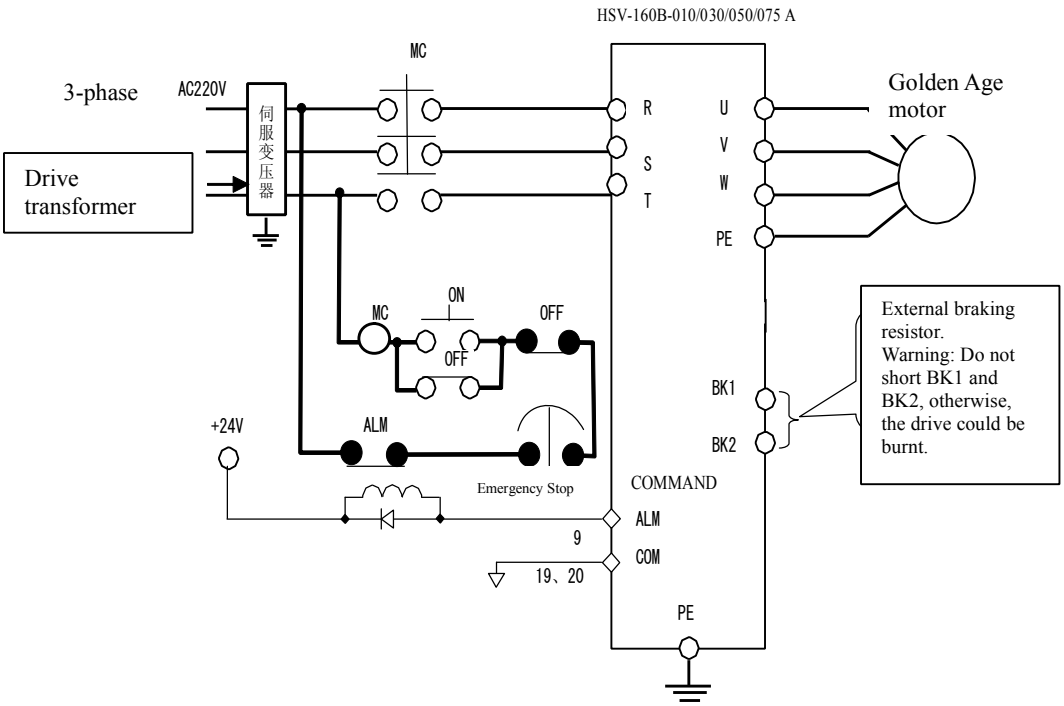
8.1 Power connection

See Figure 8.1 for the power connection wirings. Connect the power supply in the following sequence:

1. Connect the mains to the main circuit power input terminal (3-phase connect with R, S, T respectively) via electromagnetic contactor. Note: Terminal R, S, T should be correctly connected with the corresponding terminal U, V, W, otherwise, the servo drive could be damaged.
2. After the main circuit power connected, if no alarm is reported from the drive, the signal of servo ready should be valid. The time of delay is 1.5 seconds. At this moment, the enable signal can be received. If the

detected servo enable signal is valid, the servo drive output will be effective, and the motor can be excitated and operate. If the detected servo enable signal is invalid or the alarm is reported, the control circuit will shut down, and the motor will be in the free status.

Figure 8.1 Power connection wirings

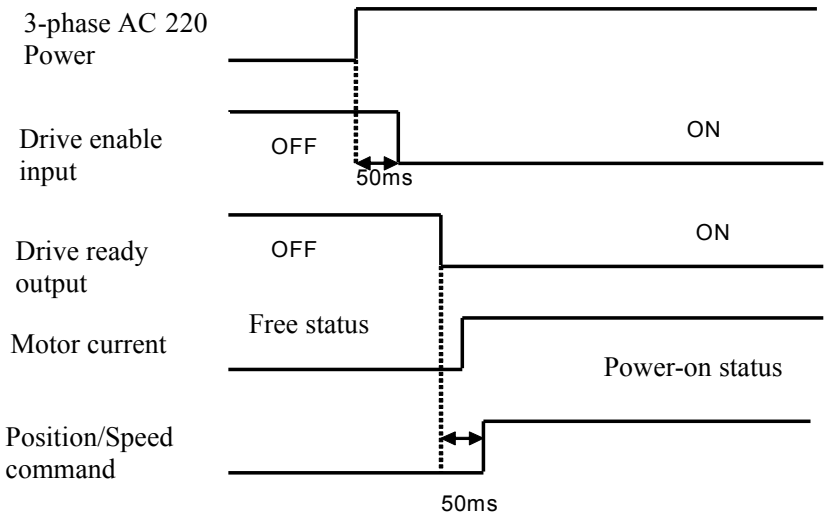


Note:

- When the drive enable and the mains are connected, the control circuit is supposed to be generated after about 1.5 seconds.
- Frequent power on and off could damage the soft start circuit.
- For the main circuit and energy consumption braking circuit, the power on and off frequency is limited to 15 times per minute. If the drive or motor is overtemperature, you should first eliminate the faults, and wait 30 minutes for connecting the power again.

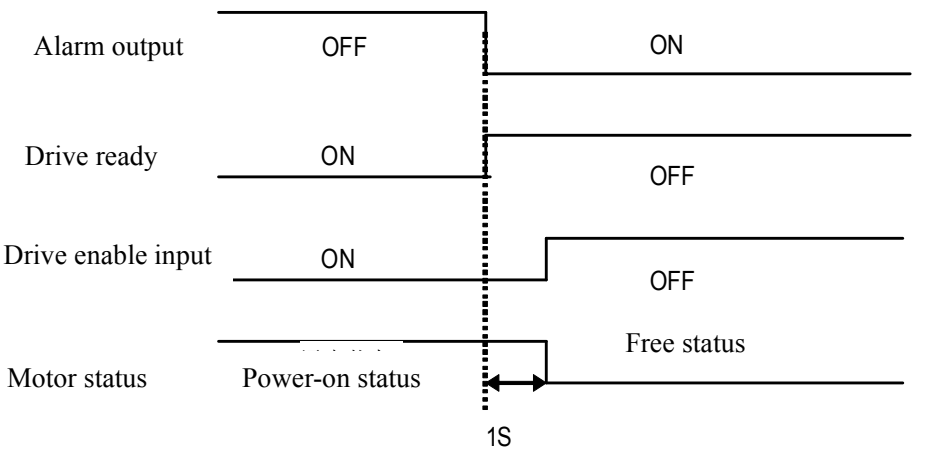
Mains connection sequence:

Figure 8.2 Mains connection sequence



Alarm sequence:

Figure 8.3 Alarm sequence



Note: When the alarm is reported, the main power should be cut off immediately via the external control circuit when the output alarm signal is generated.

8.2 Trial Operation

8.2.1 Checking before operation

After completion of the installation and connection, you should check the following items before connecting the power:

- Are all the power terminal wirings correct and reliable? Is the input

voltage correct?

- Is there any short-circuit of power cables or servo motor wires? Are they grounded?
- Are the encoder cable connections correct?
- Are the control signal terminal connections correct? Are the mains polarity and power correct?
- Are the servo drive and motor fixed firmly?
- Is the motor shaft not connected to the loads?

8.2.2 Power-on Trial Operation

1. Before power-on

- Free the motor from all loads.
- Fix the motor tightly to reduce the impact of acceleration and deceleration.

2. Wirings

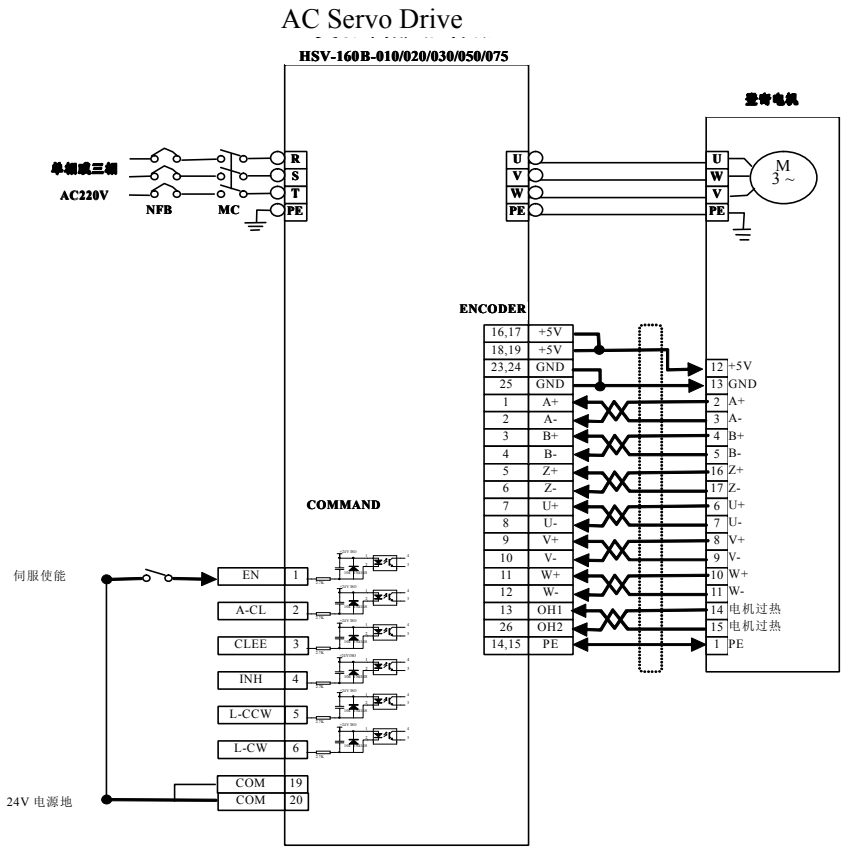
See Figure 8.4 for wirings.

① The main circuit terminals are 3-phase AC 220V, and should be well connected with the terminal R, S, T;

② Encoder signal wire connect with encoder plug-in and servo motors;

③ See the figure below for connection of control signal wire and encoder plug-in

Figure 8.4 Trial operation wiring diagram



3. JOG mode Operation

1) Connect the main power supply and command terminals. Disconnect the motor power cable U, V, W. For setting and saving the parameter PA-43, see 6.2 ***Parameter Saving and Power Removal.***

2) Connect the motor power cable U, V, W to conduct the main circuit power supply. Activate the drive enable, and it outputs control signal "ON". The drive display indicator is on. However, if an alarm is reported, you should check the wirings.

3) Set a value (other than 0) to the "JOG mode operation speed parameter PA-28, and the unit is 1 r/min.

4) Make sure that no alarm is reported and no fault occurs. Turn on the drive enable. When the indicator of the enable is bright, the motor is excited and operates at the 0 speed.

5) Press **S**, and then **M** to enter the auxiliary mode menu  . Press ▲ to select the operation status in JOG operation mode  . Press **S**, the segment displays  . Keep pressing ▲, the motor operates at the speed and direction specified by the parameter PA-21. Keep pressing ▼, the motor operates at the specified speed in the opposite direction.

6) If the external enable is not convenient to use, press **S** and then M to enter the control parameter mode menu  . Press ▲ to select  ; Press **S**, the segment displays  , press ▲ to change the value to  . See 6.2 for saving. After power removal, to restart the drive, see the operation described in 4).

4. Manual control mode for speed

1) Connect the main circuit power and command terminals. Disconnect the motor power cable U, V, W. Setting of the parameter  depends on the motor type. See 6.2 for parameter saving and power removal.

2) Connect the motor power cable U, V, W to conduct the main circuit power supply. Connect the command terminals. Activate the drive enable, and it outputs control signal "ON". The indicator lamp “EN” on the drive is on. If an alarm is reported, you should check the wirings.

3) In the motion parameter mode, to set the value of the parameter  (control method selection) to 3, it switches to the internal speed control mode. See 6.2 for the operation method.

4) Shut down the main circuit power supply, and wait 30 seconds before switching on again. After verifying that no alarm is reported and no fault occurs, the indicator lamp “EN” on the drive is on.

5) In the motion parameter mode, the motor operates at the set speed via parameter  (internal speed). Press **S** to set the motor testing speed, the motor will operate at the set speed. It is not necessary to save

this setting. See 6.2 for the operation method.

6) In particular conditions, if you need to start the motor immediately after power switching on, save the parameter (PA--20) setting in the motion parameter mode. See 6.2 for the operation method. Wait 30 seconds for switching on the drive again. The servo drive operates at the set speed via parameter PA--20. Generally, this method is not recommended.

8.3 Simple wirings in the position control mode

1) Wirings

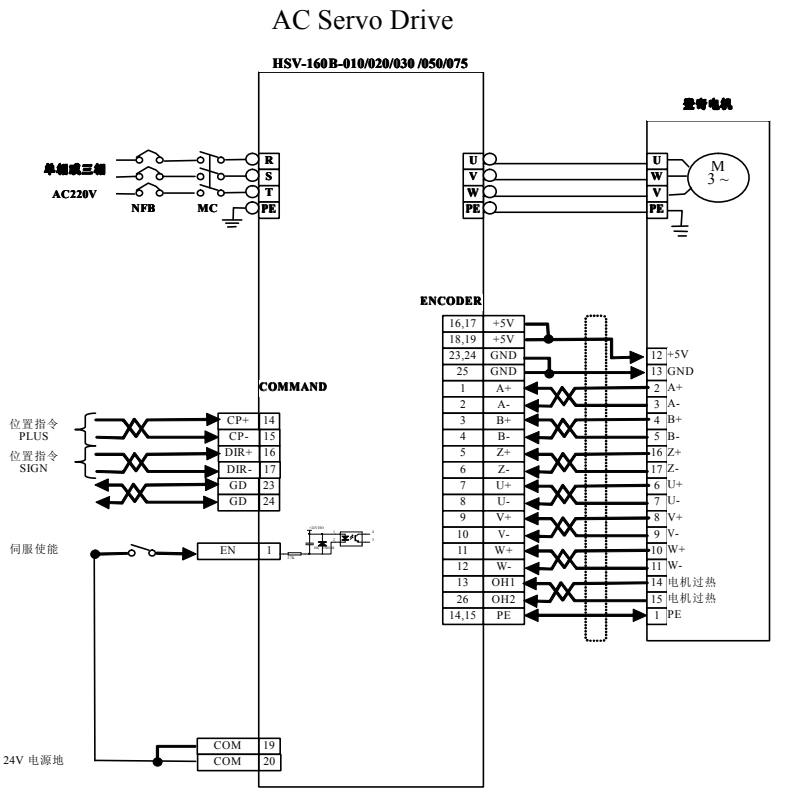
See figure 8.4 for the wirings.

① Main circuit terminals, 3-phase AC 220v, to be connected with terminals R, S, T;

② Connect the encoder signal plug-in and the servo motor;

③ Connect the control signal plug-in unit according to the drawing

Figure 8.4 Simple wiring in position control mode



2) Operation

① Connect the main power and Command terminals. Disconnect the power cable terminal U, V, W. Setting of the parameter  depends on the motor type. See 6.2 for the operation method of parameter saving and power removal;

② Connect the power cable terminal U, V, W to conduct the main circuit power. Connect the command terminals. Activate the drive enable, and it outputs control signal "ON". The indicator lamp “EN” on the drive is on. If an alarm is reported, you should check the wirings.

③ Setting and saving the parameters in accordance with the following list. See 6.2 for the operation method.

Parameter No.	Description	Parameter Value	Factory Default
	Control mode selection	0	0
	Pulse input method	Table 8.1 User-defined parameter list	0
	Electronic gear numerator	Defined by users	1
	Electronic gear denominator	Defined by users	1

Table 8.1 Position command pulse

Parameter No.	Signal Input Pin	Pulse Form		Position Command Pulse Input Setting
		Rotation in the pos. direction	Rotation in the neg. direction	
22	CP Control terminal -14，15 DIR control terminal -16，17	A B	A B	0 （orthogonal）
		CP DIR	CP DIR	1 （Pulse + direction）
		CW CCW	CW CCW	2 （CW+CCW）

④ The parameter value setting can be saved to EEPROM. See 6.2 for the operation method.

⑤ Shut down the main circuit power supply, and wait 30 seconds.

⑥ Connect the main circuit power supply. After verifying that no alarm is reported and no fault occurs, the indicator lamp "EN" on the drive is on. The motor is excited, and in the free status.

⑦ Operate the position controller, and it triggers output signal to enable the motor to rotate according to the command.

3) Electronic Gear setting

The encoder installed in this servo drive features 10000 PPR (pulse per revolution). Via setting the electronic gear parameter PA13 and PA14, any pulse equivalent can be obtained.

Table 8.2 The relationship between input pulse quantity and rotary revolutions

Input pulse quantity (Pulses)	**Motor rotary revolutions (Pulses×PA13)/(10000×PA14)**	**Electronic gear denominator**	**Electronic gear numerator PA14**
20000	1	1	2
5000	1	2	1
10000	1	1	1

8.4 Simple wirings in the speed control mode

1) Wirings

See figure 8.5 for the wirings.

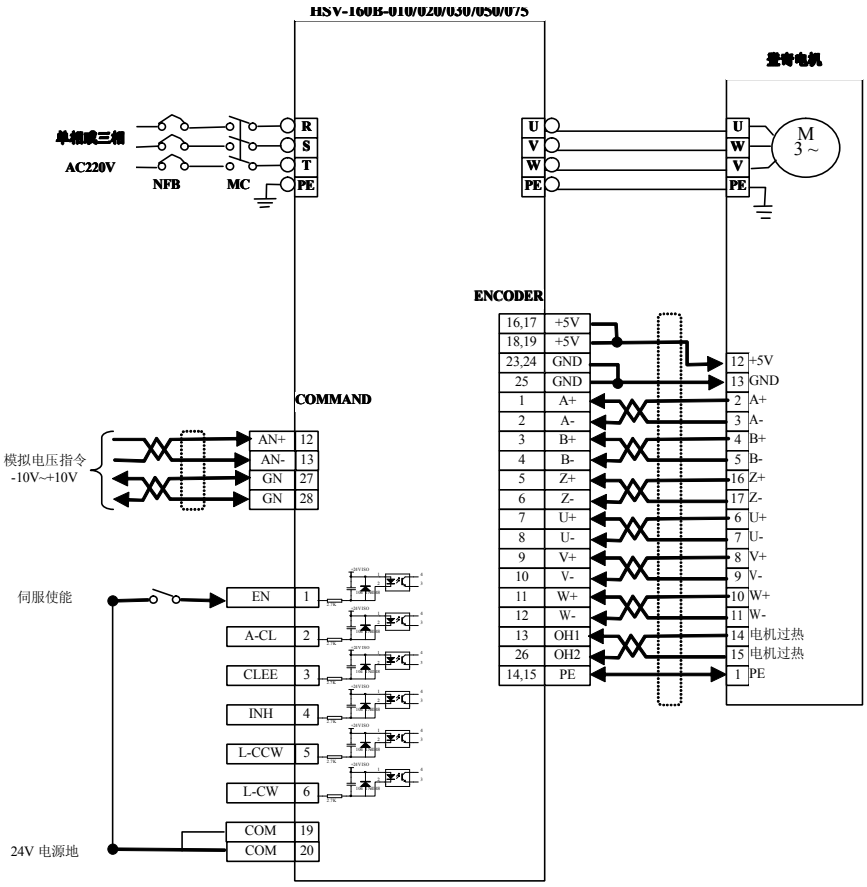
① Main circuit terminals are 3-phase, AC 220V, to be connected with the terminals R, S, T;

② The encoder signal plug-in unit should be well connected with the servo motor;

③ Connect the command signal plug-in unit according to the drawing.

Figure 8.5 Simple wiring in the speed control mode

AC Servo Drive



2) Operation

① Connect the main circuit power and Command terminals. Disconnect the motor power cable terminal U, V, W. Setting of the parameter  depends on the motor type. See 6.2 for the operation method of the parameter saving and power removal.

② Connect the motor power cable terminal U, V, W to conduct the main circuit power supply. Connect the Command terminals. Activate the drive enable, and it outputs control signal "ON". The indicator lamp “EN” on the drive is on. If an alarm is reported, you should check the wirings.

③ Setting and saving the parameters in accordance with the following list. See 6.2 for the operation method.

Parameter No.	Description	Parameter Value	Factory Default

Pb-23	Control method selection	1	0
PA-07	Command input gain	Setting according to the requirement	2000
PA-08	Command zero compensation	0	0
PA-06	Acceleration time	Defined by users	200
PA-38	Deceleration time	Defined by users	200

④ The parameter value setting can be saved to EEPROM. See 6.2 for the operation method.

⑤ Shut down the main circuit power, and wait 30 seconds. After verifying that no alarm is reported and no fault occurs, the indicator lamp “EN” on the drive is on. The motor is excited, and operating at zero speed.

⑥ Add one adjustable DC voltage supply to the analog speed input terminal, the voltage increases from 0 to the greater. Make sure the motor speed varies with the set command; If you set a negative voltage, the motor operates reversely;

⑦ Set the analog command voltage to 0, the motor still operates at low speed; You can adjust the parameter PA-08 to stop the motor.

⑧ Operate the analog controller output signal, and it triggers output signal to enable the motor to rotate according to the command speed.

8.5 Simple wirings in the torque mode

1) Wirings

See figure 8.6 for the wirings.

① Main circuit terminals are 3-phase, AC 220V, to be connected with the terminals R, S, T;

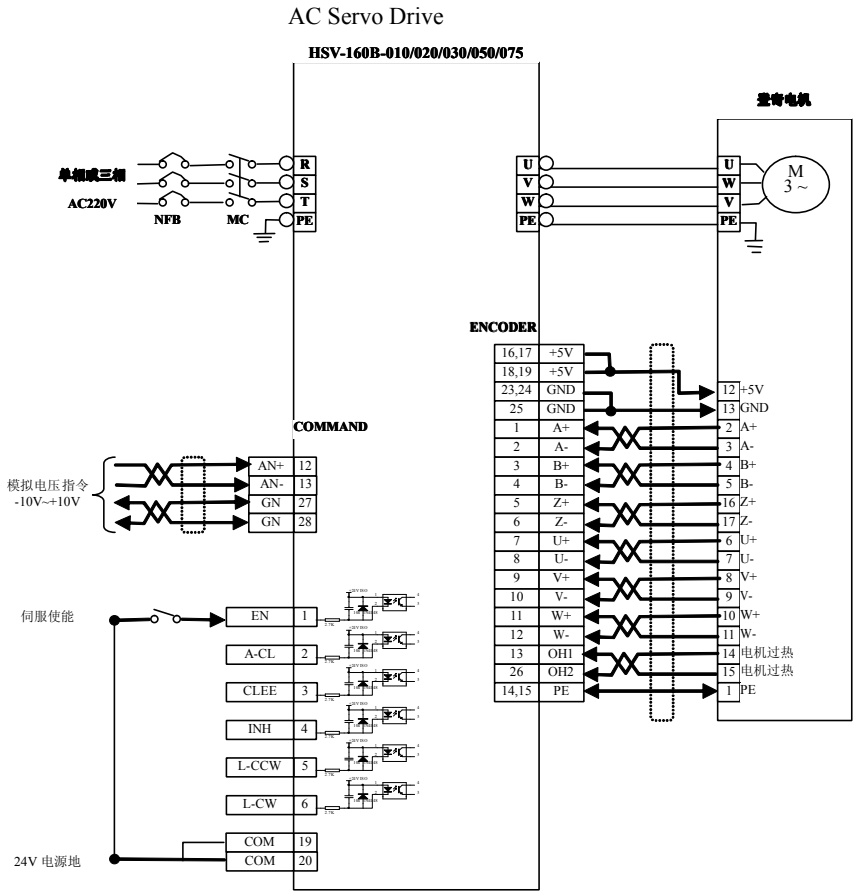
② The encoder signal plug-in unit should be well connected with the servo

motor;

③ Connect the command signal plug-in unit according to the drawing.

2) Operation

Figure 8.6 Simple wiring diagrams in the torque control mode



① Connect the main power circuit and COMMAND terminals. Disconnect the motor power cable terminal U, V, W. Setting of the parameter  depends on the motor type. See 6.2 for the operation method of parameter saving and power removal.

② Connect the motor power cable terminal U, V, W to conduct the main circuit power supply. Connect the COMMAND terminals. Activate the drive enable, and it outputs control signal "ON". The indicator lamp “EN” on the drive is on. If an alarm is reported, you should check the wirings.

③ Setting and saving the parameters in accordance with the following list. See 6.2 for the operation method.

Parameter No.	Description	Parameter Value	Factory Default
P0-23	Control mode selection	2	0
P3-09	Command input gain	To be defined as per requirements	20000
P3-10	Command zero compensation	0	0
P3-17	Highest speed limit	Defined by users	2500

④ The parameter value setting can be saved to EEPROM. See 6.2 for the operation method.

⑤ Shut down the main circuit power, and wait 30 seconds.

⑥ Connect the main circuit power supply. After verifying that no alarm is reported and no fault occurs, the indicator lamp “EN” on the drive is on. The motor is excited, and operating at zero speed.

⑦ Add one adjustable DC voltage supply to the analog speed input terminal, the voltage increases from 0 to the greater. Make sure the motor output torque varies with the set command; If you set a negative voltage, the motor outputs torque in the reverse direction;

⑧ Set the analog command voltage to 0, the motor still triggers torque output. You can adjust the parameter P3-10 to reduce the output torque to 0.

⑨ Note that motor could easily run over speed when the load is too light. Motor speed limit can be set via parameter P3-17 to prevent motor over speed with light load;

⑩ System overload occurs if the torque exceeds the nominal torque, and the servo drive can run only for a short period. For details about overload, see system overload features.

8.6 Tuning

Attention

- Wrong parameter setting could result in device faults and accidents; therefore, before starting make sure the parameters are correctly set.
- It is suggested that testing be done without load first, and then with load.

8.6.1 Basic gain

- Speed control
  - Setting the parameter [Speed proportional gain] (PA-002). As the parameter set value grows, the gain and stiffness increase. The parameter set value depends on the servo drive type and the load conditions. Set a greater value as possible, when no oscillation occurs. In general, the parameter set value increases as the load inertia grows.
  - Setting the parameter [Speed integral time constant] (PA-003).As the parameter set value decreases, the integral speed becomes faster. According to the given conditions, set a smaller value as possible. If the parameter set value is too small, the response speed is improved, but it easily produces oscillation. Therefore, set a smaller value as possible when no oscillation occurs. If the parameter set value is too great, the motor speed changes greatly as the load varies. In general, the parameter set value should be greater as the load inertia increases.
- Position control
  - Setting the appropriate values to the parameters [speed ratio gain] and [speed integral time constant] in the same operation method.
  - If the parameter value of PA-004 [position loop feedforward gain] is great, the response speed of the system will be improved, but it easily leads to the systematic position instability and the oscillation. Normally, we set 0 to this parameter value.
  - Setting the value of the parameter PA-000 [Position loop proportional gain]. If the set value of the parameter becomes

greater, the gains and stiffness also increase. In the same frequency command pulse conditions, the hysteresis decreases. The parameter set value depends on the servo drive type and the load conditions. Set a greater value as possible, when no oscillation occurs. But if the set value of the parameter [Position loop proportional gain] is too great, it easily produces oscillation in spite of good tracking characteristic of position command and less hysteresis.

- If the requirement for position tracking characteristic is high, the set value of [position loop feedforward gain] can be increased. But if the set value is too great, it leads to overshooting and oscillation.

Note 1: See the following list for the setting of the parameter [position loop proportional gain]

Table 8.2 Recommended settings of the position loop proportional gain

Stiffness	[position loop proportional gain]
Low stiffness	100 to 300 /(0. 1Hz)
Medium stiffness	3000 to 500/(0. 1Hz)
High stiffness	5000 to 700/(0. 1Hz)

8.6.2 Electronic Gear Setting

In the position control mode, via setting the parameter  [Position command pulse numerator frequency] and the parameter  [Position command pulse denominator frequency], it can easily adapt to the various controller pulses to achieve the optimal position control resolution. The position resolution depends on the travel of the servo motor per revolution (the stroke per pulse ⊿S), and the encoder feedback pulse quantity (P_t) per revolution. The relationship can be explicit by the following formula:

$$\Delta l = \frac{\Delta S}{P_t}$$

Thereof:

⊿l indicates the travel length of a pulse (mm).

⊿ S indicates the travel length of the servo motor per revolution (mm/revolution).

P_t indicates the encoder feedback pulse quantity per revolution (Pulses per revolution).

The quadruple frequency circuit exists in the system unit, so $P_t = 4 \times C$, and "C" stands for encoder windings per revolution. In this system, C = 2500 windings/revolution. This value can be set via the parameter PA-25[Encoder Resolution]. Via calculation, we know that P_t = 10000 pulses/revolution.

The command pulse can be converted into position control pulse via multiplying the electronic gear ratio G. Therefore, one pulse command travel Δl^* can be calculated as follows:

$$\Delta l^* = \frac{\Delta S}{P_t} \times G$$

Thereof,

$$G = \frac{\text{position control pulse frequency division numerator}}{\text{position control pulse frequency division denominator}}$$

8.6.3 Tuning start-up and stop characteristic

The drive system start-up and stop characteristic is namely the acceleration and deceleration time. It depends not only on the load inertia, start-up and stop frequency but also on the servo motor and drive performance limitation. Frequent start-up and stop, too short periods for acceleration and deceleration, and too great load inertia, all these factors could result in alarms of drive and motor overtemperature, or main circuit over voltage etc. Therefore, the tuning should be done in accordance with the actual situations.

1. Load inertia & start-up and stop frequency

In case of frequent start-up and stop frequency occasions, you should first check whether the frequency is permitted by the drive. The permitted frequency range varies with the motor type, capacity, load inertia and the motor rotary speed. In the condition "load inertia = m * motor inertia", the

permissible start-up and stop frequency of the motor and the recommended settings of the acceleration and deceleration time parameter (PA-06 PA-38) are listed below:

Table 8.3 Load inertia factor and the permissible start-up and stop frequency

Load Inertia Factor	**Permissible Start-up and Stop Frequency**
m ≤ 3	> 100 times per min.: Acceleration and deceleration time ≤ 60mS
m ≤ 5	60 to 100 times per min.: Acceleration and deceleration time ≤ 150mS
m > 5	< 60 times per min.: Acceleration and deceleration time > 150mS

2. Motor type influence

The permissible start-up and stop frequency and the acceleration and deceleration time depend on the motor type, load conditions, operating time, load occupying ratio, and ambient temperature etc. Tuning is supposed to be done in accordance with the actual situations with reference to the motor manual. Avoid overtemperature alarms or other influences, otherwise, the drive and motor service life will be shortened.

3. Tuning method

In general, the value of the load inertia should be within 5 times of the motor rotor inertia. If the load inertia is great, during deceleration, the overvoltage or unconventional braking could occur in the main circuit. You can use the following method to deal with it:

- Increase the acceleration and deceleration time via the parameters PA-06 and PA-38. First set a greater value, and then gradually reduce to an appropriate one.
- Reduce the max. output torque setting value via parameter PA-05 and lower the current limit.
- Lower the motor max. speed limit via parameter PA-17.
- Install an external regenerative braking device.

- Replacing a motor with greater power and inertia. (Note: The motor should be configurable with the drive.)

8.7 Frequently Asked Problems

8.7.1 Parameter default setting recovery

Use the parameter default setting (factory setting) recovery function in the event of following situations:

- If the parameter settings are incorrect, the drive system can not operate normally;
- If the system power shuts down when you are saving the parameter settings, the system parameter settings will automatically recover to defaults. But the drive and motor type code parameter  can not be matched with the motor.
- Use the original motor to configure with the drive. If the new motor type is different from that of the original, you should recover the parameter default settings following the approaches below:

1. Press **M** to switch to  mode. Select  in the first layer. Press ▲, ▼ to select the parameter  . Press **S**, the segment displays  . The parameter setting recovery is completed, but it takes effect only after saving.
2. Press **S** again, and then **M**. Press ▲, ▼ to select the parameter  . Press ▲, ▼ once, the parameter value changes 1. Keep pressing ▲ or ▼, the parameter value changes continuously. Press **S** to return to the parameter selection menu without saving. To save the changes or settings, you should input the password  to the parameter  . Press **M** to switch to  mode. Press **S** to save the changes and settings to the drive EEPROM. After saving complete, the segment displays  , or otherwise, it displays

 .

3. After parameter recovery saving complete, the parameter values will be recovered to defaults after switching on again.
4. Parameter recovery values depend on the parameter  . The kilobit of the parameter indicates the motor brand (Huada motor or Golden Age motor). If you use Huada motors, the parameter values will be recovered to Huada motor defaults; If you use Golden Age motors, the parameter values will be recovered to Golden Age motor defaults.

8.7.2 Deficient output contributions in the process of tuning

With the default values of the parameters  ,  ,  , and  , the drive output contribution is not satisfying, but the drive alarm already reports software overtemperature (). You should adjust the parameter  [Motor Overload Factor], provided the setting of the parameter  is correct.

8.7.3 Current loop tuning

If the drive and motor code parameter  is correct, the parameters  ,  ,  ,  ,  will be automatically tuned. It is not necessary to set the parameters manually unless some special occasions as follows:

1. In the operation, the motor current produces loud noises. You can lower the value of the parameter  [Current control loop proportional gain], and increase the value of the parameter  [Current control loop integral time]. If the effect is not obvious, you can change the value of the parameter  [Speed feedback filter factor] to the range of 0 to 2. In the ordinary course of events, do not change the parameter  .
2. When the motor is operating at 0 speed, the drive is enabled and the motor is excited. If the motor shaft produces low frequency vibration

noise, you should lower the value of the parameter PA--27 [Current control loop proportional gain] and increase the value of the parameter PA--28 [Current control loop integral time]. If the effect is not obvious, you can change the value of the parameter PA--32 [Torque command loop filter time constant] to the range of 4 to 15. Besides, you can set the value of the parameter PA--04 [Speed feedback filter factor] to the range of 0 to 2. In the ordinary course of events, do not change the parameter PA--04.

8.7.4 Change of parameters should be done regardless of the motor and drive combination type

In the particular conditions, the relationship between the drive and motor is not listed in the table 7.4 or table 7.5 or there is no corresponding motor code. If the ratio of the motor nominal current and the drive effective current is not greater than 1.2, to change the parameter values, you can follow the procedure below:

1. Connect the drive power cable terminal R, S, T and the motor encoder terminals. (Note: Do not connect the motor terminal U, V, W);
2. Setting the value of the parameter PA--34 = 2003, and change the motor related parameters: Pb--24 [Nominal current], Pb--25 [Nominal rotary speed], Pb--26 [Motor rotary inertia], Pb--27 [Nominal torque], PA--24 [Motor pole logarithm], PA--25 [Motor encoder resolution], PA--26 [Motor deviation]. See 6.2.1 for the operation method;
3. Setting the parameter PA--18: PA18×PB24 ≤ Effective current of the drive (listed on the nameplate)
4. Setting the parameter PA--27: $PA27=L\times10^3\times K_{fc}\times1240/10^6$;

Note:

1) Motor inductance (Unit: mH);

2) Current feedback factor K_{fc}:

HSV-160B+-010	K_{fc}: = 120
HSV-160B+-020	K_{fc}: = 187
HSV-160B+-030	K_{fc}: = 250
HSV-160B+-050	K_{fc}: = 465
HSV-160B+-075	K_{fc}: = 667

5. Setting the parameter  : PA28 = L (Motor inductance, unit: mH)/R (Motor resistor, unit:Ω) (unit: ms) × 10;

6. Setting the value of the parameter  = 1230. Connect the motor power cable U, V, W to carry out the test operation. In this situation, do not perform the parameter recovery function, otherwise, the parameters will be recovered to the default settings.

Chapter 9 Diagnostics and Troubleshooting

Attention
● Only qualified personnel who have the corresponding professional knowledge and capabilities can work on the drive system. ● To touch the drive and motor, you should wait at least 5 minutes after power removal. Failure to follow this instruction could result in electric shock and burnt. ● If the drive triggers an error response in the event of a fault, you should clear the error depending on the error code. After that, you can use the drive. ● Before the alarm reset, verify that the "EN" signal is disabled. Otherwise, the abruptly started motor could cause unexpectable accidents.

9.1 Protective diagnostic function

- HSV-160B^{+} type drives provide 18 protective functions and diagnostics.

When one of the protective functions is activated, the segment on the drive panel displays the corresponding error response, and a drive alarm will be reported.

- When use the drive, the alarm output and fault interlock output circuit should be connected in the emergency stop loop. If the drive protective function is activated, the main power supply can be cut off in time (Cut off the 3-phase main power supply, but the control power supply is still on).
- After troubleshooting, switch on the drive power again to clear the alarms; Or pressing keys on the operation panel to enter the auxiliary mode, and clear the alarms via alarm reset function.
- Some of the alarms can not be eliminated via alarm reset function. You can cut off the power supply, after troubleshooting, switch on the power again to clear the alarms.

Table 9.1 Alarm list

Alarm code	Error response	Description
	Normal	
	Main circuit undervoltage	The main circuit power is undervoltage.
	Main circuit overvoltage	The main circuit power is overvoltage.
	IPM module fault	IPM (intelligent power module) fault occurs.
	Braking fault	Braking circuit fault occurs.
	Fuse blowing out	The main circuit fuse blows out.
	Motor overtemperature	The motor is overtemperature.
	Encoder signal fault	Absolute encoder signal fault occurs.
	Encoder U, V, W signal fault	Encoder U, V, W signal fault occurs.
	Reserved	
	Overcurrent	The motor is overcurrent.
	System overspeed	The servo motor speed exceeds the set value.
	Tracking error is great.	The actual value displayed on the position deviation counter exceeds the set the value.
	Motor long-time overtemperature and overload	The actual current value exceeds the set value (via I^2t detection)
	Control parameter reading error	EEPROM parameters can not be read correctly.
	Control panel hardware fault	The processor peripheral logic circuit fault occurs.
	AD conversion fault	AD conversion circuit or current sensor fault occurs.

	Reserved	
	Reserved	
	Command frequency fault	The position loop pulse command frequency is too high.
	System operating over travel in the pos. direction	Limit switch in the pos. direction disconnects
	System operating over travel in the neg. direction	Limit switch in the neg. direction disconnets
	Parameter autotuning failure	Motor parameter setting is incorrect or the inertia cannot be recognized due to great load connection elasticity.
	Wrong combination of motor and drive	The settings of motor and drive codes are not appropriate.

9.2 Troubleshooting

Table 9.2 Error causes and troubleshooting

Alarm code	Error	Operating status	Cause	Troubleshooting
1	Main circuit undervoltage	Occurs when connecting the main power supply	① Circuit board failure. ② Mains fuse blows out. ③ Soft-start circuit failure. ④ Commutator is damaged.	①Change the servo drive.
			① Power supply is undervoltage. ② Temporary powerdown for more than 20mS	①Check the power supply.
		Occurs in the process of motor operation	① Mains capacity is inadequate. ② Instantaneously powerdown.	① Check the power supply.
			① The heat sink is overtemperature.	①Check the load conditions.
2	Main circuit overvoltage	Occurs when connecting the main power supply	① Power supply is overvoltage. ② Mains voltage wave is unconventional.	①Check the power supply.
		Occurs in the process of motor operation	①External braking resistor wires disconnect.	①Check the external braking circuit, do the wirings again.
			① Braking transistors are damaged. ② Internal braking resistors are damaged.	①Change the servo drive.

			①Braking circuit capacity is inadequate.	① Lower the start-up and stop frequency. ② Increase the time constant for acceleration and deceleration. ③ Reduce the torque limit. ④ Reduce the load inertia. ⑤ Change a drive and motor with a greater power.
3	IPM fault	Occurs when connecting the main power supply	①Circuit board failure.	①Change the servo drive.
		Occurs in the process of motor operation	① Voltage supply is low. ② Servo drive is overtemperature.	① Check the servo drive. ② Switch on the power again. ③ Change the servo drive.
			① Short-circuit exists in the drive line U, V, W.	①Check the wirings.
			① Not well grounded.	① Correct the wirings.
			①Motor insulation is damaged.	①Change the motor.
			①Drive output current is too great.	① Increase the time constant for acceleration and deceleration. ② Reduce the torque limit.
			①Interference.	① Add line filters. ② Away from the interference source.
4	Braking fault	Occurs in the process of motor operation	①External braking resistor wires disconnect.	①Do the wirings again.
			① Braking transistors are damaged. ② Internal braking resistors are damaged.	①Change the servo drive.
			①Braking circuit capacity is inadequate.	① Lower the start-up and stop frequency. ② Increase the time constant for acceleration and deceleration. ③ Reduce the torque limit. ④ Change a drive and motor with greater power.
			①Main circuit voltage is too great.	①Check the main power supply.
5	Fuse blowing out	Occurs in the process of motor operation	① Short-circuit exists in the drive external line U, V, W.	①Check the wirings.
			①Not well grounded.	①Correct the wirings.

			①Motor insulation is damaged.	①Change the motor.
			①Drive is damaged.	①Change the servo drive.
			①Operation in the over torque condition.	① Check the loads. ② Lower the start-up and stop frequency. ③ Reduce the torque limit. ④ Change a drive and motor with greater power.
			① One of the phases in the line U, V, W disconnects. ② Encoder wiring incorrect.	①Check the wirings.
6	Motor overtheat	Occurs when connecting the main power supply	①Motor overheat protective wire is not connected.	①Shielding this alarm.
			①Circuit board fault.	①Change the servo drive.
			① Cables disconnect. ② Motor internal temperature relay is damaged.	① Check the wirings. ② Check the motor.
		Occurs in the process of motor operation	①Motor overload	① Reduce the load. ② Lower the start-up and stop frequency. ③ Reduce the torque limit. ④ Reduce the related gains. ⑤ Change a drive and motor with greater power.
			①Long-time operation in the condition of over nominal torque.	①Check the load. ②Lower the start-up and stop frequency. ③ Reduce the torque limit. ④ Change a drive and motor with greater power.
			①Mechanical transmission is not in good condition.	①Check the mechanical parts.
			①Motor internal faults.	①Change the servo motor.
7	Encoder signal fault		①Encoder wirings are incorrect.	①Check the wirings.
			①Encoder is damaged.	①Change the motor.
			①External interference.	① Add line filters. ② Away from the interference source.
			①Encoder cables are not in the good condition.	①Change the cables.

			①Encoder cables are too long, so the voltage supply to the encoder is reduced.	① Shorten the cable length. ② Use multi core cables in the parallel connection for power supply.
8	Encoder U, V, W fault		①Encoder wirings are incorrect.	①Check the wirings.
			①Encoder is damaged.	①Change the motor.
			①External interference.	① Add line filters. ② Away from the interference source.
			①Encoder cables are not in the good condition.	①Change the cables.
			①Encoder cables are too long, so the voltage supply to the encoder is reduced.	③ Shorten the cable length. ④ Use multi core cables for the power supply.
9	Reserved			
10	Over current		①Short-circuit exists in the drive line U, V, W.	①Check the wirings.
			①Motor overload.	⑥ Reduce the load. ⑦ Lower the start-up and stop frequency. ⑧ Reduce the torque limit. ⑨ Reduce the related gains. ⑩ Change a drive and motor with greater power.
			①Not well grounded.	①Correct the grounding.
			①Motor insulation is damaged.	①Change the motor.
			①Drive is damaged.	①Change the servo drive.
11	System overspeed	Occurs when connecting the main power supply	① Control circuit board fault. ② Encoder failure.	① Change the servo drive. ② Change the servo motor.
		Occurs in the process of motor operation	① Input command pulse frequency is too high.	①Set the correct input command pulse.
			①Acceleration and deceleration time constant value is too small, and the speed overshooting is too great.	①Increase the time constant for acceleration and deceleration.
			①Input electronic gear ratio value is too great.	①Correct the setting.
			①Encoder failure.	①Change the servo motor.
			①Encoder cables are not in the good condition.	①Change the encoder cables.
			①Drive system is instable which causes overshooting.	① Reset the related gains. ② If changing the gain setting can not reduce the system instability, you can reduce the load rotary inertia ratio.

		Occurs when the motor is started.	① Load inertia is too great.	① Reduce the load inertia. ② Change a drive and motor with greater power.
			①Encoder zero point error.	① Change the motor. ② Tuning the encoder zero point.
			① Incorrect wiring of motor U, V, W. ② Incorrect wiring of encoder cable down-lead.	①Correct wirings.
12	Tracking error overtolerance	Occurs when connecting the main power supply	①Circuit board failure.	①Change the servo drive.
		Connecting the power supply and the control wires, input the command pulses, motor stands still	① Incorrect wiring of motor U, V, W. ② Incorrect wiring of encoder cable down-lead.	①Correct wirings.
			①Encoder failure.	①Change the servo motor.
		Occurs in the process of motor operation	①Set the range of positioning out-of-tolerance.	①Widen the range of positioning out-of-tolerance
			①Position loop proportional gain is too small.	①Increase the gain.
			①Torque deficient.	① Check the torque limit. ② Reduce the load capacity. ③ Change a drive and motor with greater power.
			①Command pulse frequency is too high.	①Lower the frequency.
13	Motor overload		①Torque deficient.	① Check the torque limit. ② Reduce the load capacity. ③ Change a drive and motor with greater power.
			①Servo drive failure.	①Change the servo drive.
			①Interference.	① Increase the line filters. ② Away from the interference source.
14	Control parameters reading error		①Instability of the input power supply.	① Check mains voltage. ② Check the mains power.
			①Servo drive failure.	① Change the servo drive.
			①Interference.	① Increase line filters. ② Away from the interference source.
15	DSP fault		Instability of the input power supply.	① Check the mains voltage. ② Check the mains power.

			①Servo drive failure	① Change the servo drive.
			①Interference.	① Increase the line filters. ② Away from the interference source.
16	Alarm		①Instability of the input power.	① Check the mains voltage. ② Check the mains power.
			① Servo drive failure.	①Change the servo drive.
			①Interference.	① Increase the line filters. ② Away from the interference source.
17	Reserved			
18	Reserved			
19	Command frequency failure		Position command pulse frequency is too high.	Lower the frequency command pulse: Use the orthogonal command pulse form.
20	System operating over travel in the pos. direction		Positive limit switch disconnect.	Check the positive limit switch status.
21	System operating over travel in the neg. direction		Negative limit switch disconnect.	Check the negative limit switch status.
22	Parameter autotuning failure		Incorrect motor parameter or incorrect recognition of the inertia due to great load connection elasticity	Check and reset the motor parameter or the load device.
23	Incorrect motor and drive combination.		Inappropriate motor and drive type code settings.	Reset the motor and drive type code.

Chapter 10 Service and Maintenance

The drive guarantee period:

18 months after out-of-factory date or 1 year from the handover date to users.

Attention
● You can not carry out the repairs yourself. Power connection/switch off should be carried out by a certified customer service operator. ● Even after power removal, the circuit still maintains high voltage charging status for a period of time. Wait 5 minutes for checking after power is removed and the LED light is off. ● Do not carry out the insulation resistance measuring. This can damage the drive.

10.1 Routine inspection

When the system operates in common conditions, please check the followings items:

1) Whether the ambient temperature and humidity are normal. Whether dust, particles and foreign bodies etc. exist;
2) Whether motor produces abnormal noises and vibration;
3) Whether it gives off heat and peculiar smell abnormally;
4) Whether the ambient temperature is too high;
5) Whether the panel is clean
6) Whether exist loose connections or incorrect pin positions;
7) Whether the common current figures and the output current monitoring figures are quite different;
8) Whether the cooling fan under the servo drive operates normally. The cooling fan temperature is controlled by the temperature relay, and it operates only when the heat sink temperature is ≥ 35°C.

10.2 Regular checking

When carry out the regular service, please check the following items:

1) Whether exist loose bolts;

2) Whether exist overtemperature;

3) Whether exist burnt terminals.

10.3 Replacing parts

Attention
● For checking or repairs, the parts removal should be carried out by our technical personnel or our agent.

Parts replacing cycle depends on the actual operating conditions and device using conditions. Disabled parts should be repaired or replaced immediately.

Device	Parts	Standard replacing cycle	Remark
Drive	filter capacitor	About 5 years	This standard replacing cycle is only for reference, any way, the disabled parts should be repaired or replaced immediately once found out.
	cooling fan	About 3 years	
	Aluminium electrolytic capacitor on the PCB board	About 3 years	
Motor	bearing	3 to 5 years	
	oil seal	5000 hours	
	encoder	3 to 5 years	

Annexure

Selection and connection of the braking resistor

The braking voltage of the HSV-160B$^+$ AC servo drive is DC 400 V, and the max. braking currents are listed in the table 12.1. The internal braking resistor of the drive is 70Ω/200W, and the max. overload permitted is 1.5 times of the internal braking resistor (for 5 seconds continuously). When the drive loads or the inertias are great, external braking resistors should be installed. Generally, as the loads and inertias increase, the braking time will be shortened. If the selected braking resistor value decreases, the resistor power will be increased, but the max. braking current should not exceed the max. braking current of the drive.

If only use the internal braking resistor, the mains terminal BK1 and BK2 of the drive should be disconnected (the drive factory default indicates only internal braking resistor). Warning: Short-circuit of the mains terminal BK1 and BK2 will result in drive burnt.

If you use external braking resistors, the external braking resistors should be connected to the drive mains terminal BK1 and BK2. The internal braking resistor and the external braking resistors are connected in parallel. The recommended values of the external braking resistors are listed in the table 12.1:

Table 12.1 The recommended values of the external braking resistors

Specification	Max. braking current (A)	External braking resistor (recommended)
HSV-160B^{+}-010	20	68Ω 200W
HSV-160B^{+}-020	20	56Ω 500W
HSV-160B^{+}-030	20	56Ω 500W
HSV-160B^{+}-050	50	35Ω 500W
HSV-160B^{+}-075	75	35Ω 500W